TEKTRONIX® 1976 TELEVISION PRODUCTS

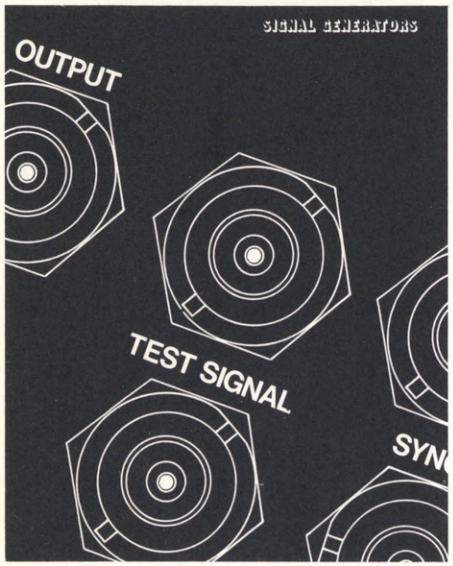
Television Products
Time, Test, Measure,
Correct and Display
the Television Signal.

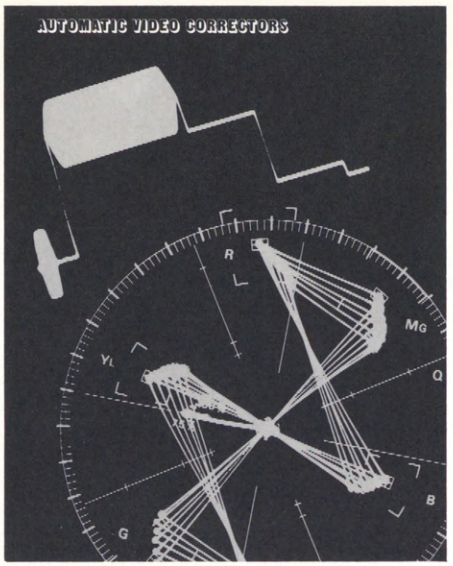
TEKTRONIX Television Products Time, Test, Measure, Correct, and Display the Television Signal.

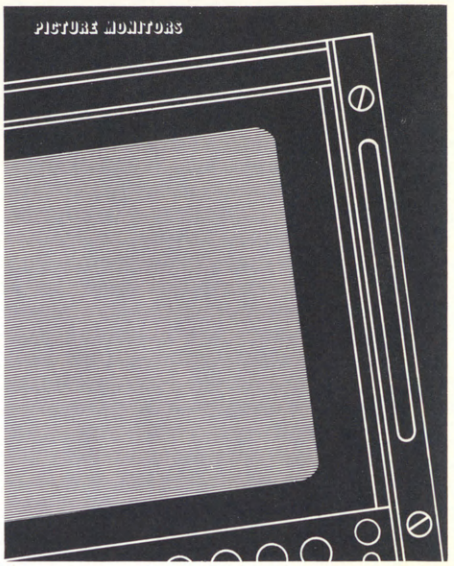
The television signal is a complex analog signal—a signal requiring precise timing—a signal that must be measured in terms of volts by engineers and judged in terms of picture fidelity by engineers and production people. This signal degrades cumulatively with every centimeter of travel. Consider the many processes a video signal undergoes on its way to the receiver—each process providing new opportunities for unwanted changes to the signal.

Unwanted changes to the composite video signal include differential gain, differential phase, linear distortions, noise return loss, and so forth. Individually, or in combination, these can cause an unstatisfactory picture.

This is where TEKTRONIX Television Products come in—TEKTRONIX Television Products time, test, measure, correct, and display the composite video signal for NTSC, PAL, SECAM, and PAL-M systems.







3/41 Picture Monitors

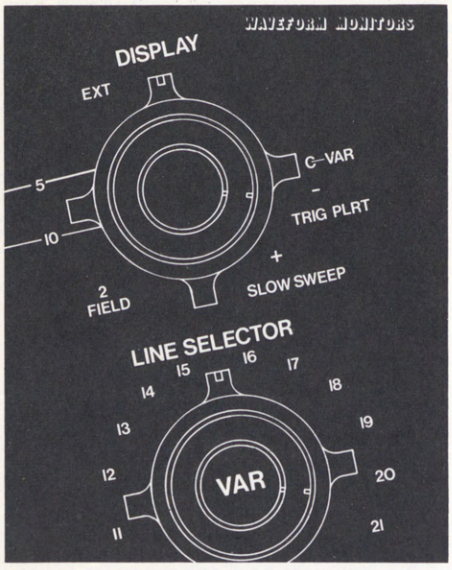
All of the many signals needed to time and accurately test broadcast and closed-circuit color video equipment are provided by TEKTRONIX Television Signal Generators. There are generators for NTSC, PAL, and PAL-M described fully starting on page 3.

42/49 Video Correctors

TEKTRONIX Automatic Video Correctors use a reference signal located in the vertical blanking interval to correct the video signal. Correctors for NTSC and PAL are described fully starting on page 42.

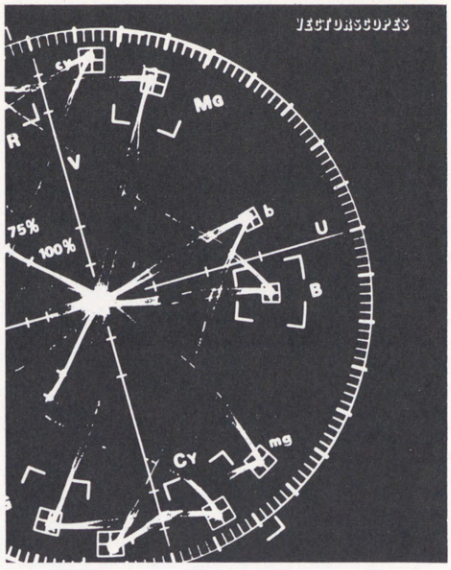
50/58 Signal Generators

TEKTRONIX Picture Monitors have the features and accuracy to reliably assess picture quality in the color system appropriate to your location. Complete descriptions will be found starting on page 50.



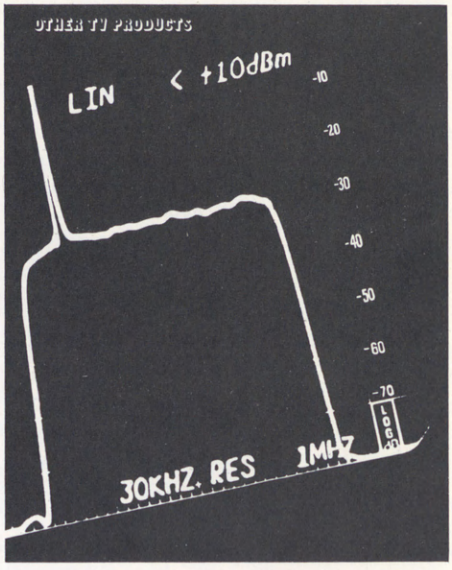
59/68 Waveform Monitors

The Waveform monitor is a specialized oscilloscope with special triggering and vertical characteristics for the measurement of the composite video signal. Waveform Monitors for all 625/60 and 625/50 systems are described fully starting on page 59.



69/81 Vectorscopes

Vectorscopes are specially designed to display and examine the chrominance signal in fine detail. Vectorscopes for NTSC, PAL, and PAL-M are fully described starting on page 69.



82/93 Other TV Products

When you work with signals that are not one volt of video across 75-ohms, our Other Products will be of interest. This section provides an overview of these other products, plus some details about selected items that we feel will be of particular interest to the Television Industry and to the industries that use television.

The 1976 Tektronix General Catalog—The complete reference for all Tektronix Products not specifically designed for Television applications is the General Catalog. For a copy, use the response card located after page 48 (U.S. only).

Sources of Information

ASSISTANCE

This catalog is designed to provide reasonably complete descriptions and specifications of Tektronix Television Products. Additional literature and answers to your individual questions are available through Tektronix people in your area. See the listing of offices on the back cover.

APPLICATION NOTES

From time to time Tektronix Engineers produce application notes detailing Television measurement techniques. Your Tektronix Field Engineer can supply you with back issues relevant to your systems and standards.

MAILING LIST

In the United States we periodically mail application notes, catalogs, and other technical literature to individuals on our mailing list. If you are not receiving these items we suggest using the response card in this catalog.

GLOSSARY OF TELEVISION TERMS

ACTIVE VIDEO LINES: All video lines not occuring in the vertical blanking interval.

APL: The average signal level, with respect to blanking level, during the active picture scanning time expressed as a percentage of difference between blanking and reference white. (IEEE Def)

BACK PORCH: That portion of the composite video signal which lies between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLANKING LEVEL: The level of the composite picture signal that separates the range containing picture information from the range containing synchronizing information. (IEEE Def)

BREEZEWAY: The portion of the back porch between the trailing edge of the sync pulse and the start of the color burst.

BURST FLAG: A keying or gating signal used in forming the color burst from a chrominance subcarrier source. (IEEE Def)

B-Y: A Color difference signal obtained by subtracting the luminance signal from the blue camera signal. It is plotted on the 0° - 180° axis of a vector diagram.

CHROMINANCE SIGNAL: That portion of the color television signal which contains the color information (STOC Def)

COLOR BAR: A test signal, typically containing six basic colors: yellow, cyan, green, magenta, red, and blue, which is used to check the chrominance functions of color TV systems.

COLOR BURST: In color systems, this normally refers to a burst of subcarrier frequency located on the back porch of the composite video signal. This serves as a color synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOR SUBCARRIER: In color systems, this is the carrier signal whose modulation sidebands are added to the monochrome signals to convey color information.

COMPOSITE BLANKING: The complete television blanking signal composed of both line rate and field rate blanking signals (see also Line Blanking and Field Blanking).

COMPOSITE SYNC: The line and field rate synchronizing pulses (including field equalizing pulses) when combined together, form the composite sync signal.

COMPOSITE VIDEO: The color picture signal plus blanking and all synchronizing signals. (STOC Def)

CONVERGENCE: In color television, the meeting or crossing of the three electron beams at the shadow mask.

CROSSHATCH: A test pattern consisting of vertical and horizontal lines used for converging color monitors and cameras.

DIFFERENTIAL GAIN: The difference in output amplitude (expressed in percent or dB) of a small high frequency sine-wave signal at two stated levels of a low frequency signal on which it is superimposed. (IEEE Def)

DIFFERENTIAL PHASE: The difference in output phase of a small high frequency sine-wave signal at two stated levels of a low frequency signal on which it is superimposed. (IEEE Def)

EIA: An abbreviation for Electronic Industries Association.

EQUALIZING PULSES: Pulses of one half the width of the horizontal sync pulses which are transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse. The purpose of these pulses is to cause the vertical deflection to start at the same time in each interval, and also serves to keep the horizontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD: One of the two (or more) equal parts of information which a frame is divided in interlace scanning.

FIELD BLANKING: Refers to the blanking signals which occur at the end of each field used to make the vertical retrace invisible. Also called vertical blanking.

FIELD FREQUENCY: The rate at which one complete field is scanned.

FRAME: One complete picture consisting of two fields of interlaced scanning lines.

FRONT PORCH: That portion of the composite picture signal which lies between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding horizontal sync pulse.

H RATE: The time for scanning one complete horizontal line, including trace and retrace.

HORIZONTAL DRIVE: A pulse at horizontal rate used in TV cameras. Its leading edge is coincident with the leading edge of the horizontal blanking pulse and the trailing edge is coincident with the trailing edge of the horizontal sync pulse.

HUE: The attribute of color perception that determines whether the color is red, yellow, green, blue, etc.

IRE: An abbreviation for Institute of Radio Engineers.

IRE SCALE: An oscilloscope scale that applies to composite video levels. There are 140 IRE units in 1 volt.

—I, W, Q, B: An NTSC test signal used to check television broadcast equipment. It consists of a —I signal followed by a white bar then a Q signal and a black level on each line.

LINE BLANKING: The blanking signal at the end of each horizontal scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY: The number of horizontal scans per second, normally 15,734.26 times per second for NTSC color systems.

LUMINANCE: The amount of light intensity, which is perceived by the eye as brightness (referred to as "Y").

NTSC: National Television Systems Committee. An industry-wide engineering group which, during 1950-1953, developed the color television specifications now established in the United States.

REFERENCE WHITE LEVEL: The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

R-Y: A color difference signal obtained by subtracting the luminance signal from the red camera signal. It is plotted on the 90° - 270° axis of a vector diagram.

SATURATION: This indicates how little a color is diluted by white light.

SETUP: The separation in level between blanking and reference black levels.

STAIRCASE: A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by a subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

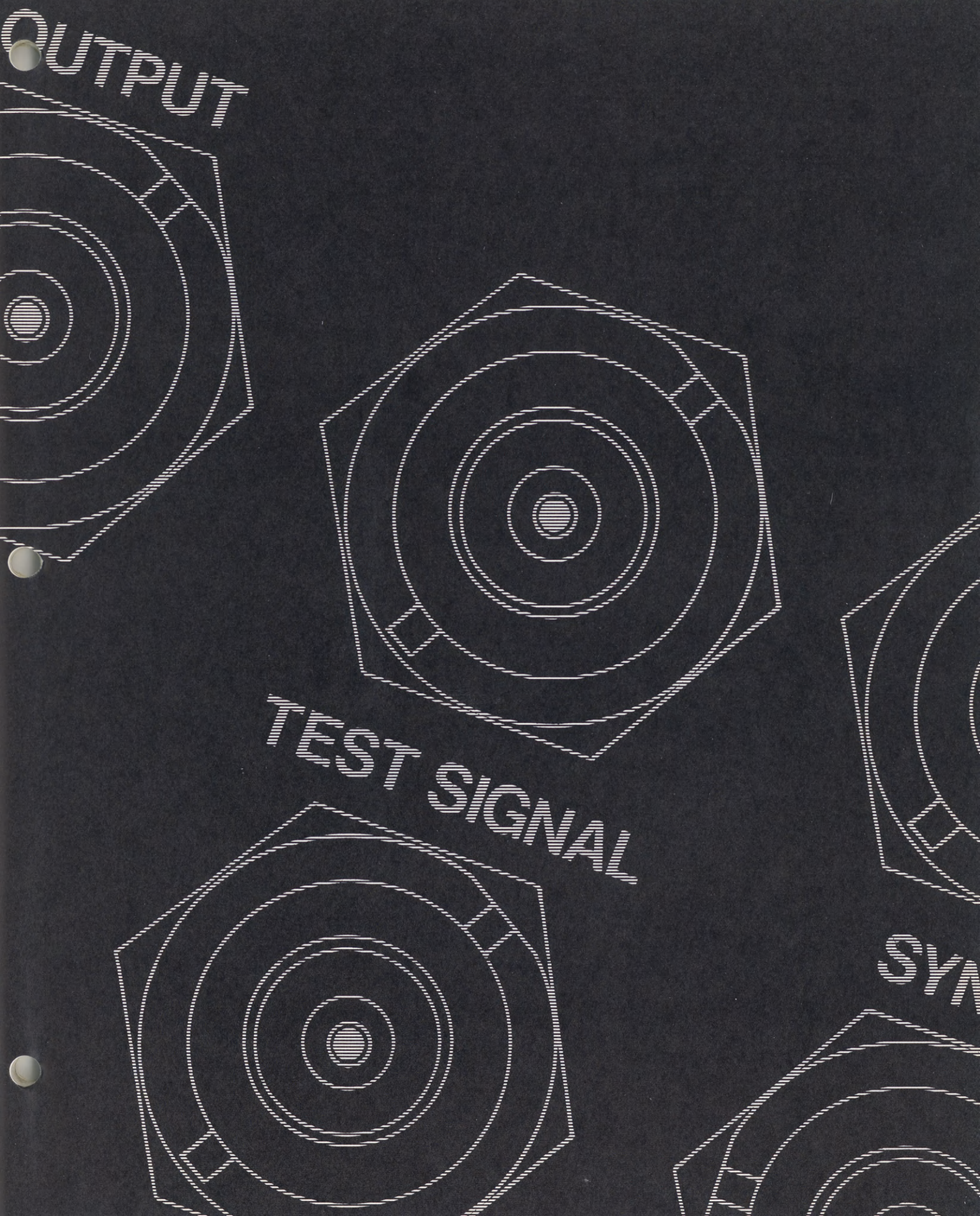
SYNC: An abbreviation for the words "synchronization", "synchronizing", etc. Applies to the synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The color sync signal (NTSC) is known as the color burst.

VERTICAL BLANKING INTERVAL: The blanking portion at the beginning of each field. It contains the equalizing pulses, the vertical sync pulse, and VITS (if desired).

VERTICAL DRIVE: A pulse at field rate used in TV cameras. Its leading edge is coincident with the leading edge of the vertical blanking pulse and its duration is 10½ lines.

VITS: Vertical interval test signal. A signal which may be included during the vertical blanking interval to permit on-the-air testing of the video system.

SIGNAL GENERATORS



NTSC GENERATORS

This information is intended to guide you to the best generator for your needs.

TEKTRONIX Television Signal Generators are compact sources of high-quality test and synchronizing signals. All signals needed to time and accurately test, evaluate and adjust NTSC broadcast and closed circuit color video equipment are available. This year two new generator series have been added (the 1410 Series and the 1470 Series). The 1410 Series features the advantages of modularity at prices usually associated with single-piece construction. The 1470 Series are single piece units that are economical and compact and are especially attractive for closed circuit television applications. The information on this page is an overview intended to guide you to the best generator for your needs. Final selection should be based on the detailed information on the following pages.

Sync and Timing Signals

	1410 SPG1	1410 SPG2	1470	1474	140	144	146
Gen-lock Input		●	●	●			●
External Comp Sync Input	●	●			●	●	
External Subcarrier Input	●	●			●	●	●
Black Burst Output	●	●	●	●			
Comp Sync Output	●	●	●	●	●	●	●
Subcarrier Output	●	●	●	●	●	●	●
Comp Blanking Output	●	●	●	●	●	●	●
Burst Flag Output	●	●	●	●	●	●	●
H Drive Output	●	●	●	●	●	●	●
V Drive Output	●	●	●	●	●	●	●

Test Signals

	TSG1	TSG2	TSG3	TSG4	SPG1 SPG2	1470	146 144 140	147A	149A
VIRS				●	*			VITS ONLY	VITS ONLY
EIA Colors Bars	●						●		
Full-Field Color Bars	●					●	●		●●
Color Bars/Y Ref	●						1		●
Color Bars/Red Ref	●								
Color Bars/Reverse	●								
Red Field						●			
Blue Field						●			
Green Field						●			
Modulated 5-Step Staircase			●			●	●	●●	●●
Modulated 10-Step Staircase			●				●	●●	●●
Modulated Ramp			●					●●	●●
Modulated Pedestal			●				●		●●
Composite Test Signal								●●	●●
Convergence Signal		●				●	●		
Black Burst				●	●	●			
Full/Reduced Amplitude Multi Burst								●●	●●
Sin^2 Pulse and Bar								●●	●●
Sin^2 Pulse and Window						2		●	●●
Field Square Wave								●	●
Noise Measuring Capability								●●	
Flat Field/Variable Level			●				●	●	●
Flat Field/Bouncing Level			●					●	●
Test Signal/ Variable APL			●				●	●	●

A few signals may require reprogramming and some signals may not be available simultaneously.

Test Signals: 1) 144/146 2) Window only

● Full-Field Signal ●● Full-Field signal, also available as VITS.

* As a VIT signal on the Black Burst output.

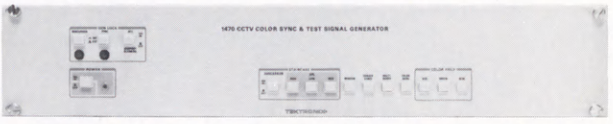
Sources of EIA Sync and Color Standard Signals plus Test Signals

New—1410 Generator Mainframe with SPG2 Sync Generator Module installed. No Test Signal Modules are installed. Pages 5.

New—1410 Generator Mainframe with SPG2 Module plus several Test Signal Generator Modules. Page 5.

146 Gen-Lock NTSC Test Signal Generator. Page 11.

Closed Circuit Sync Generator and Color Standard plus Test Signals



1470 CCTV Color Sync and Test Signal Generator. Page 11.

Closed Circuit Sync Generator and Color Standard

1474 CCTV Color Sync Generator. Page 11.

Insertion Generators

147A NTSC Test Signal Generator. Page 13.

149A NTSC Test Signal Generator. Source of Transmitter Remoting Signals. Page 13.

Timing Signals—The 147A and 149A produce composite sync and subcarrier outputs when gen-locked.

Special Insertion Generators

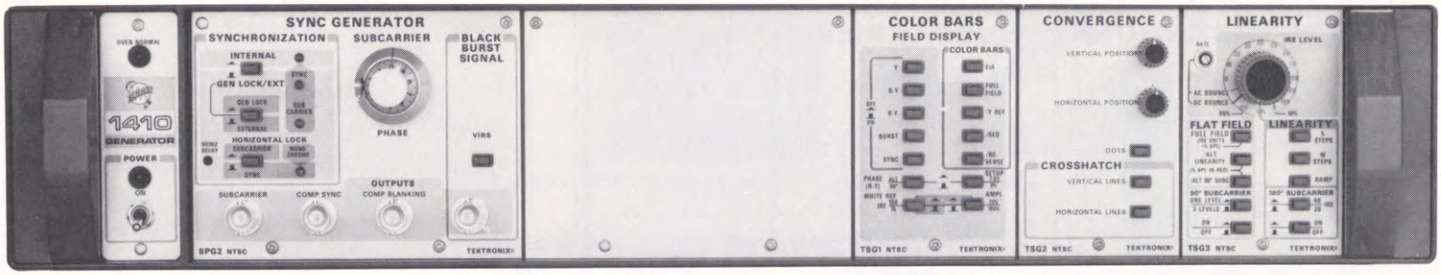
1430 Random Noise Measuring Set. Page 41.

1441 VIR Signal Deleter/Inserter. Page 47.

NEW 1410 SERIES

NTSC GENERATORS

All the advantages of modularity at prices usually associated with single-piece construction.



The 1410 Mainframe with a typical complement of modules: the SPG2 (left) and the TSG1, TSG2, TSG3. A two-wide blank panel 333-2162-00 covers the spaces reserved for additional test signal modules.

Plug-In Card Construction

Select just the functions you need now.

Add functions as you need them.

Economy

Sync Pulse Functions

Choice of Three Sync Generator Modules

Choice of Four Test Signal Generator Modules

The 1410 Series of NTSC Sync Pulse and Test Signal Generators offers all the advantages of modularity at prices generally associated with units of single-piece construction. To suit your specific needs, you may choose from a wide selection of sync pulse and test signal generator functions to be combined in the mainframe providing the color standard of your choice. Should you develop additional test signal requirements in the future, our plug-in card construction insures a quick and easy retrofit for you. Any combination of five test signal generators driven by one sync pulse generator is feasible.

THE MAINFRAME

The 1410 Mainframe unit includes the power supply, an extender board, an interface board, and the color-standard circuitry. Two color-standard circuits are available. The standard 1410 Mainframe generates chrominance subcarrier accurate to within 10-Hz of nominal color subcarrier frequency. The 1410 Option 1 Mainframe generates a very stable chrominance subcarrier accurate to within 1-Hz of nominal. Each color standard has a proportional control oven for the quartz crystal and the entire oscillator circuit. A front-panel lamp indicates proper operation of the oven.

1410 Characteristics

1410 Subcarrier Frequency (Fsc)— 3.579545 MHz ±10 Hz. Option 1: 3.579545 MHz ±1 Hz.

1410 Pull-In Range—Fsc ±100 Hz. Option 1: Fsc ±20 Hz.

Subcarrier Input Requirements—Amplitude: 1.0 V to 4.0 V p-p. Frequency: 3.579545 MHz ±10 Hz.

Subcarrier Return Loss— ≥ −46 dB to 3.579545 MHz.

Mechanical Specifications—Length: 19.2 in; 48.77 cm. Width: 19.0 in; 48.26 cm. Height: 3.47 in; 8.81 cm.

Mains Voltage Ranges— 90-112 Vac, 106-132 Vac, 180-224 Vac, and 212-250 Vac. Factory set at 106-132 Vac.

Crest Factor—At least 1.35.

Max Power Consumption— 130 W.

Max Amps at 120 Vac, 60 Hz—1.2 A.

Mains Frequency— 50-60 Hz.

Comp Blanking—Line blanking duration: 11.12 μs nominal, adjustable 9 to 12 μs.

THE MODULES

The Sync Pulse Modules and the Test Signal Modules plug vertically onto the 1410 Mainframe interface board. Front-panel controls and switches are mounted on the module with easily removable extenders projecting through the front panels.

Available modules include three sync-pulse generators, a color bars generator, a convergence pattern generator, a linearity signal generator, and a VIRS/Black burst generator.

SYNC PULSE GENERATION

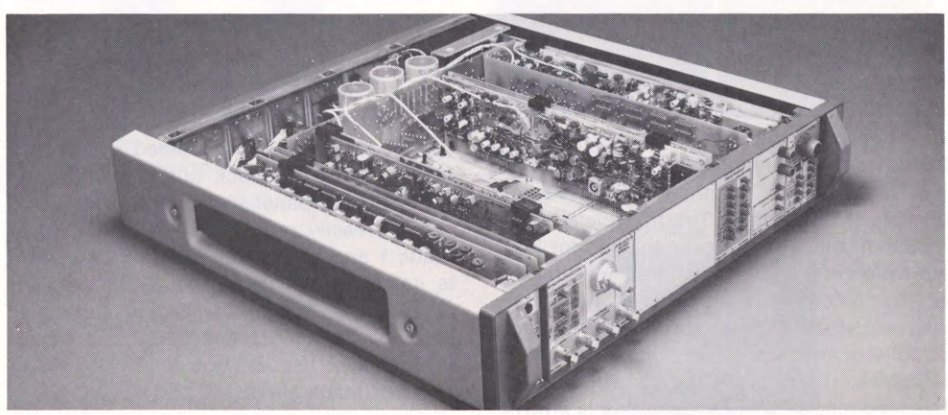
The Sync Pulse Modules SPG1 and SPG2 have three basic functions:

One—Provide sync and timing signals for use in your facility.

Two—Provide sync and timing for the Test Signal Modules TSG1, TSG2, TSG3, and TSG4.

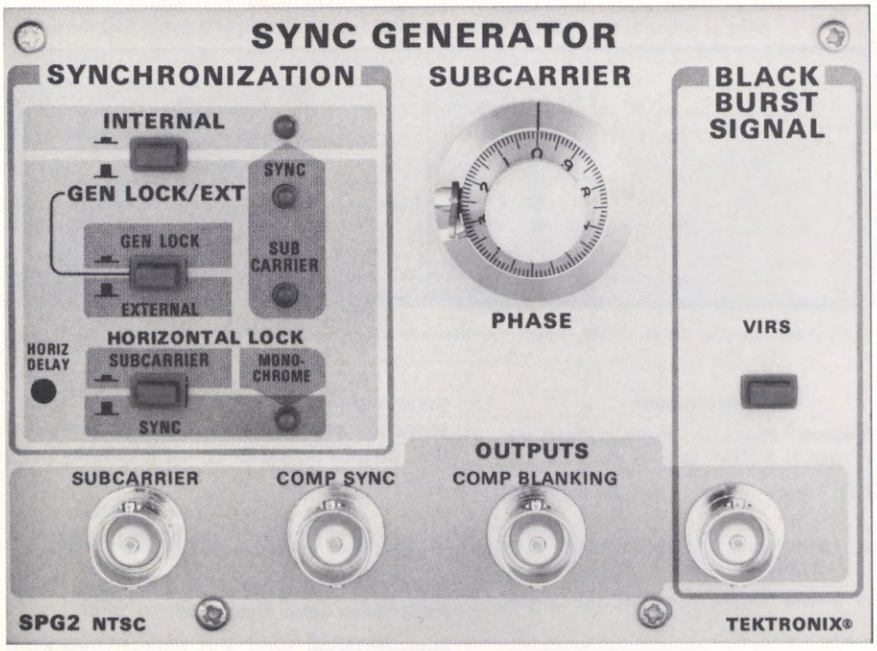
Three—Provide a black burst signal with or without the vertical interval reference signal.

When the function of providing sync and timing for the Test Signal Modules in the 1410 Mainframe is your only requirement, the SPG3 can be used for extra economy. There are no sync and timing or black burst outputs available from the SPG3. When Black Burst and the Vertical Interval Reference Signal Outputs are desired, a TSG4 can be used with the SPG3 to provide an economical source of those signals. The SPG3 does provide subcarrier and oscilloscope triggers from front panel outputs.

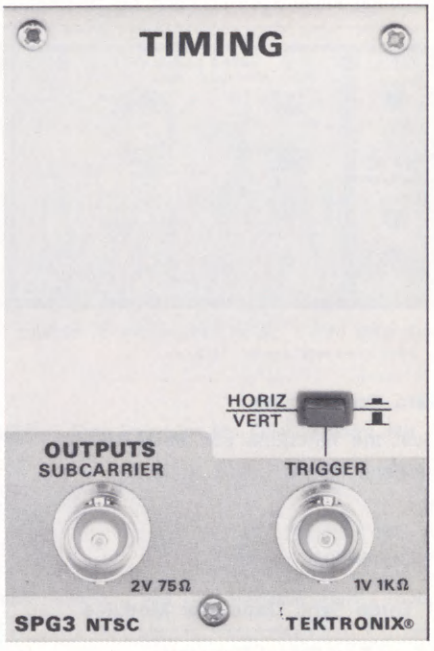


The plug-in card construction of the 1410 Series is designed for retrofitting ease.

NEW SPG1, SPG2, SPG3



The SPG2 Sync Generator has provision for gen-lock operation. The almost identical SPG1 (not shown) does not have gen-lock capability. (Actual size)



The economical SPG3 is designed for use in 1410 Packages where test signals without sync outputs are required. (Actual size)

SPG1 AND SPG2

The SPG1 and SPG2 are identical except that the SPG2 provides color gen-lock operation. The SPG2 Generator, operated in the gen-lock mode, can synchronize the time of occurrence of field, frame, line, and subcarrier from composite video input. Color gen-lock (SPG2 only), external subcarrier, or internal subcarrier (from the 1410 Mainframe) can be selected for color standard reference. Front-panel lamps indicate loss of incoming sync and/or subcarrier due to excessive noise and/or low amplitude. Indicator lamps also indicate monochrome operation. A slow-lock mode can be selected to minimize disturbances to VTR's that are often caused by switching the gen-lock input between non-synchronous sources. The slow-lock selector is located on the generator plug-in module. Should incoming reference signals be interrupted, the user can elect to cause loss of sync to inhibit all test signals and loss of subcarrier to inhibit the subcarrier portion of all signals. The front-panel LED indicator may be lit or extinguished for loss indication at the user's discretion. With loss of the incoming sync signal, the SPG2 switches to either internal sync reference or to full-internal timing (internal jumper selectable). If horizontal lock selection is in the sync mode, full internal timing is always selected when sync is lost. Loss of subcarrier or incoming burst switches the SPG2 to either full-internal gen-lock or to sync lock (internal jumper selectable). Internal adjustments permit some variation of burst flag and comp blanking pulse output widths. These adjustments are preset to conform to FCC standards. Blanking width adjustments permit users to reduce widths initially to allow for the widening that sometimes occurs when the video signal is processed. A feature of interest to the VTR users is the ability of both SPG1 and SPG2 to maintain precise subcarrier to sync phasing automatically. This is a must for tape editing and program assembly.

BLACK BURST AND VERTICAL INTERVAL REFERENCE SIGNAL

The SPG1 and SPG2 provide a black burst output independent of all other outputs. The Vertical Interval Reference Signal (VIRS) is factory programmed on line 19 field 1 and 2 of black burst when turned on by a front panel switch. The VIR Signal may be easily reprogrammed to line 18 of fields 1 and 2. If black burst and the VIRS is needed when using the SPG3 the user may add a TSG4 Test Signal Generator module. The SPG1 and SPG2 can be reprogrammed to provide a full-field VIRS in place of black burst.

Characteristics SPG1, SPG2, SPG3

GEN LOCK (SPG2 ONLY)

Input Configuration— 75 Ω loop-through with return loss ≥ —46 dB to 5 MHz.

Input Requirements— 1 V nominal composite video or black burst, sync negative. Sync amplitude: 286 mV ±6 dB. Burst amplitude: 286 mV ±12 dB. Burst sync ratio: within 6 dB.

Subcarrier Phase Error with Frequency Change— Within 0.5° with input burst frequency change of ±10 Hz. Subcarrier Phase Error with Burst Amplitude Change— ±1° 210 mV to 420 mV, ±3° 75 mV to 1.2 V.

Subcarrier Phase Stability— 0.2° for burst timing errors including burst width variance (8 to 10 cycles) and breezeway variance (±0.28 μs). Within 0.1° or less with APL change from 10% to 90%. Within 1° with RMS white noise at 24 dB below nominal p-p picture signal (nominal) 714 mV.

Subcarrier Phase Range— 360° via front-panel goniometer.

Line Sync Delay Range—Adjustable to advance output sync at least 10 μs or delay at least 4 μs (internal adjustment). A front panel screwdriver adjustment provides a delay/advance range of ±0.5 μsec.

Stability (over ambient temperature range 0°C to 50°C)—Line lock: within 70 ns. Subcarrier lock: within 35 ns.

Jitter—Line lock: 10 ns or less. Subcarrier lock: 4 ns or less.

Field/Frame Sync—Fast lock: direct-acting in 1 field. Slow lock: 1 line/field slew.

EXTERNAL REFERENCE (SPG1 and SPG2)

Input Configuration— 75 Ω loop-through with Return Loss ≥ —46 dB to 5 MHz.

Subcarrier Input Requirements—Amplitude: 1.0 V to 4.0 V p-p. Frequency: 3.579545 MHz ±10 Hz. Return loss: ≥ —46 dB to 3.579545 MHz.

Comp Sync Input Requirements—Amplitude: 2.0 V to 8.0 V p-p. Polarity: negative.

Loss of Lock—Indicated by front-panel LED indicators. Automatic switching to partial or full internal reference.

Subcarrier Stability—Output follows input.

Line Sync Delay Range—Adjustable to advance output sync at least 10 μs or delay at least 4 μs (internal adjustment). A front panel screwdriver adjustment provides a delay/advance range of ±0.5 μsec.

Subcarrier Phase Range— 360° via front-panel goniometer.

OUTPUTS (SPG1 and SPG2)

Composite Sync—Equalizing pulse duration: 2.38 μs ±50 ns; sequence duration: 3 lines. Field Sync—duration 27.0 μs ±200 ns; duration 3 lines; interval between field sync pulses: 4.77 μs ±100 ns. Jitter: 4 ns or less. Line sync duration: 4.77 us ±100 ns. Return loss: ≥ —30 dB to 5 MHz. Isolation: ≥ —30 dB. Output level into 75 Ω: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Comp Blanking—Line blanking duration: 11.12 μs nominal, adjustable 9 to 12 μs. Field blanking duration: 21 lines nominal, adjustable 16 to 21 lines. Output level into 75: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Burst Flag—Delay from line sync: adjustable. Duration: 2.51 μs ±50 ns (9 cycles of subcarrier, adjustable).

Line Drive—Duration: start of line blanking to end fo line sync ±100 ns. Output level into 75: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Field Drive—Duration: 9 lines. Output level into 75: 4 V ±%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

Field Ref—Position: Field 1, line 11 or Field 3, line 10.

VIR Signal—Chrominance: amplitude 286 mV ±2.85 mV (40 IRE ±0.4 IRE); phase within 0.5° of burst; envelope rise time Sin^2 shaped, 1 μs ±150 ns. Luminance: setup level 53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE); gray level 357 mV ±3.57 mV(50 IRE ±0.5 IRE); chroma pedestal 500 mV ±5 mV (70 IRE ±0.7 IRE); rise and fall time Sin^2 shaped, 250 ns ±39 ns; Output level into 75: 4 V ±5%. Rise and fall time: linear ramp, 10% to 90% time 140 ns ±20 ns.

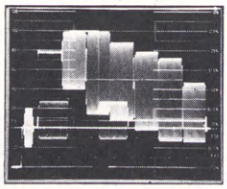
Black Burst—Amplitude: sync 286 mV ±3.57 mV (40 IRE ±0.5 IRE) negative-going; setup 53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE); burst 286 mV ±2.86 mV (40 IRE ±0.4 IRE).

Burst—H.A.D. of envelope: 2.51 μs ±35 ns. Rise and fall time : 400 ns ±60 ns.

Breezeway— 475 ns ±50 ns at 10% point.

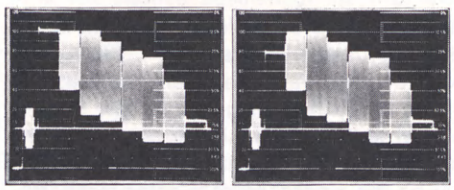
Setup—Start adjustable 9.58 μs from leading edge of line sync, stop 1.59 μs before next line sync leading adge.

EIA Color Bars



EIA color bars as defined by RS-189.

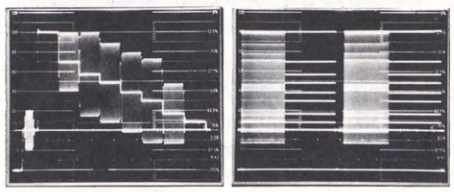
Full Field Color Bars



Left: 75% Amplitude full-field color bars with 100% white bar.

Right: 75% amplitude full-field color bars with 75% white bar.

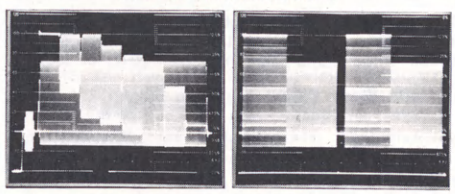
Color Bars/Y Reference



Left: Split field color bars with a luminance reference useful in gray scale tracking.

Right: Color bars/Y reference shown at field rate.

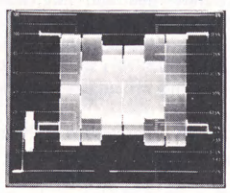
Color Bars/Red Reference



Left: Split field color bars with a red reference is a signal useful in VTR setup.

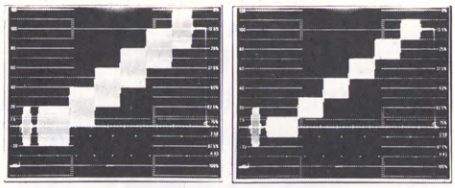
Right: Color bars/Red shown at field rate.

Reversed Color Bars



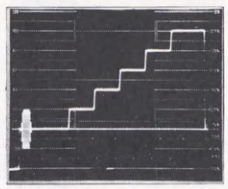
Split field color bars/color bars reversed is a signal useful for detecting chrominance to luminance delay.

5-Step Linearity Test Signal



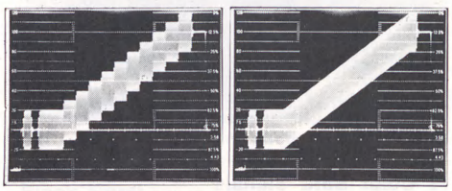
Left: 5-Step modulated linearity test signal with 40 IRE units of subcarrier.

Right: 5-Step modulated linearity test signal with 20 IRE units of subcarrier.



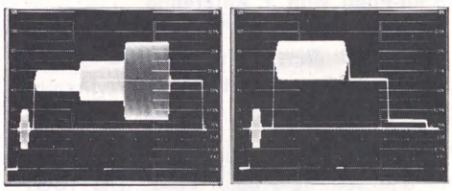
5-Step luminance linearity test signal.

10 Step Linearity Test Signal **Modulated Ramp**



10-Step modulated linearity test signal.
Modulated Ramp linearity test signal.

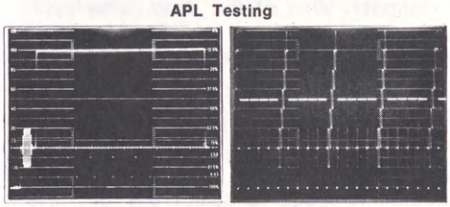
Modulated Pedestal **VIRS**



Left: 3-Level modulated pedestal within unmodulated level, a signal used for measuring the effects of chrominance on luminance.

Right: Full field version of the VIR Signal (shown at line rate).

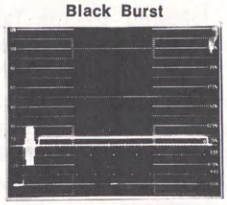
APL Testing



Left: The flat field test signal can be varied or bounced.

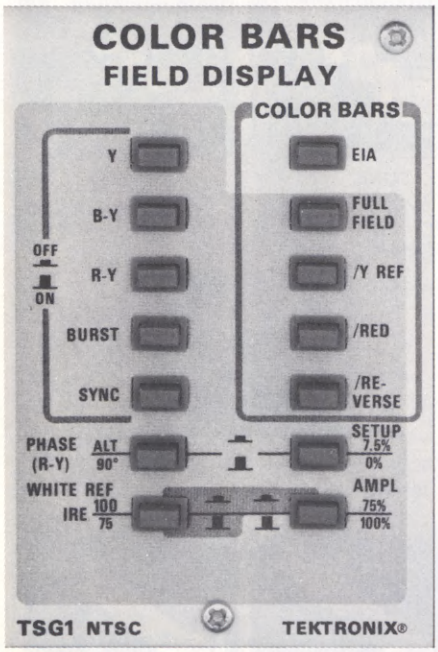
Right: The linearity Test signal alternated with flat field.

Black Burst



Black burst is available from the SPG1, SPG2, and TSG4.

NEW TSG1, TSG2



The TSG1 Bars Generator (Actual size)

Five Color Bars Signals
- **EIA**
- **Full-Field**
- **Split-Field with Y Reference**
- **Split-Field with Red Reference**
- **Split-Field: Bars/Bars Reversed**

Test Signal Components May Be Switched Off

The TSG1 is a high quality source of full-field and split-field color bars. The TSG1 operates independently of any other Test Signal Modules installed in the 1410 Mainframe with its output available simultaneously with all other test signal module outputs. One of the sync pulse modules must be installed in the 1410 Mainframe to drive the TSG1. The composition of the module's output signal can be altered by switching off Y, B-Y, R-Y, Burst, and Sync. This feature is useful in instruction, and in research and development. Provision is made to select 0% or 7.5% set up.

The /Y REF switch selects a split field display of color bars in the same sequence as full field, followed by the luminance portion of the color bars for the remainder of the field. The split can be ½ or ¾ field as selected by internal programming in the SPG1, SPG2, or SPG3. Signal provides a means for checking picture monitor gray scale tracking while simultaneously evaluating color performance.

The/RED switch selects a split-field display of color bars as in /Y REF, followed by red chrominance. (Same phase and amplitude, at the same luminance level as the red bar). This signal is useful in adjusting VTR playback controls. Head equalization errors and noise are easily spotted on a red field.

The /REVERSE switch selects a split-field display of color bars as in /Y REF, followed by color bars in a reverse sequence. (Black, blue, red, magenta, green, cyan, yellow, white). This signal helps detect chrominance to luminance delay while viewing the kinescope of a color monitor/receiver.

Both the setup level and the white reference level are front panel selectable. Setup may be set at 0% or 7.5%. White reference may be set at 100% or 75%.

CHARACTERISTICS
Electrical Specifications

Luminance Signal Accuracy—Within 1% or 1.5 mV, whichever is greater.

Chrominance Accuracy—Absolute Amplitudes: within 3% (all subcarrier components). Relative Amplitudes: within 1% or 1 mV plus p-p residual subcarrier amplitude, whichever is greater, of the red chrominance bar.

Full Field Displays—Bar width: 6.45 μs. White bar rise time: 135 ns ± 15 ns. Time difference between chroma and lum channels: 20 ns or less.

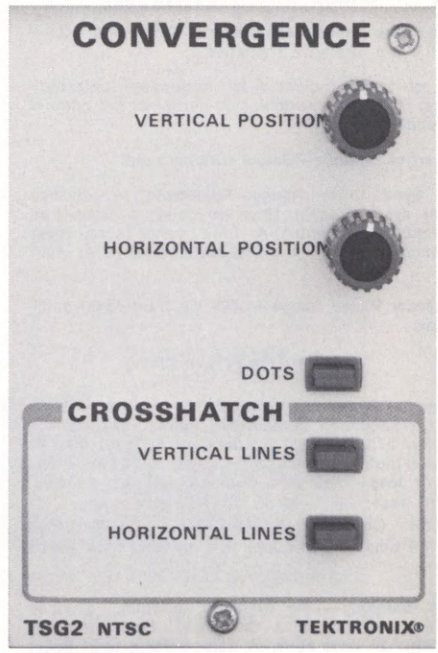
Composite Video Output—Total amplitude: 1 V into 75 Ω. Sync amplitude: —285.7 mV ± 2.86 mV. Peak Level Amplitude: 714.3 mV ±7.14 mV. Blanking dc level: 0 V ± 50 mV. Return loss: ≥ —30 dB. Isolation: ≥ —40 dB. Field period: 16.68 ms. Line period: 63.56 μs. Rise and fall time— 135 ns ± 15 ns. Front porch duration— 1.59 μs ± 50 ns at 50% point, 1.52 μs at 10% point. Line blanking interval— 11.1 μs. Breezeway— 475 ns ± 50 ns at 10% point. Burst—Rise and fall time: 400 ns ± 60ns. Delay from Line Sync: 5.309 μs (19 Cycles of subcarrier) ± 35 ns. H.A.D. of envelope: 2.51 μs (9 cycles of subcarrier) ± 70 ns. Amplitude: 285.7 mV ± 8.75 mV. Phasing on successive lines: 180°.

SPLIT FIELD DISPLAYS

Color Bars /Y Ref—(Selected by plug-jumper on Sync Timing board in SPG.) Color bars: ½ or ¾ field, selectable. Ref: ½ or ¼ field, selectable.

Color Bars /Red— (Selected by plug-jumper on Sync Timing board in the SPG.) Color bars: ½ or ¾ field, selectable. Red: ½ or ¼ field, selectable.

Color Bars/Reverse—(Selected by plug-jumper on Sync Timing board in SPG.) Color bars: ½ or ¾ field, selectable. Reverse sequence: ½ or ¼ field field, selectable.



The TSG2 Convergence Generator (Actual size)

Convergence Test Signals

Dots and Crosshatch

Dots Only

Vertical Lines Only

Horizontal Lines Only

Vertical and Horizontal Lines

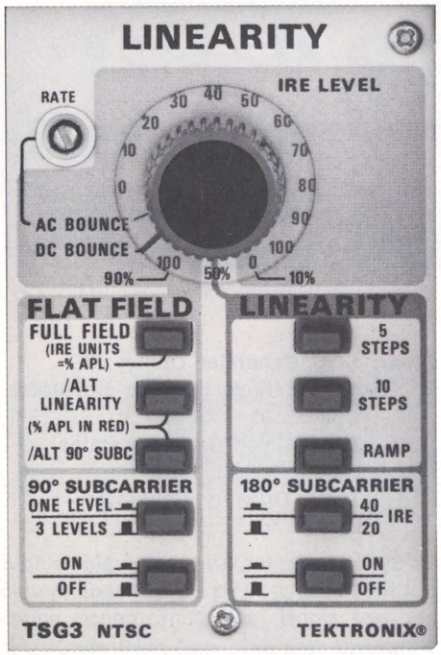
Positionable

The TSG2 is a high quality source of convergence test signals. It is useful for determining picture monitor or camera scanning linearity, aspect ratio, and geometric distortion. Signals conform to IEEE Standard 202. Provision is made for on/off switching of the dots, vertical lines, and/or horizontal lines. Vertical and horizontal line positioning is provided. The signal output is located on the rear panel of the 1410 Mainframe in which the TSG2 is installed. The convergence signal output is available simultaneously with all other test signal module outputs.

Characteristics

Displays Available—Crosshatch, vertical lines only, horizontal lines only, dots only, and crosshatch plus dots (dots appear centered in the rectangles formed by the crosshatch pattern).

Convergence Pattern—Setup: 7.5 IRE ± 1. Sync amplitude: 40 IRE ± 2. Peak level: 77 IRE ± 3. Rise and fall time 135 ns ± 15.



The TSG3 Linearity Generator (Actual size)

Staircase

5-Step

10-Step

Ramp

Modulated Pedestal

One-Level

Three-Level

Flat Field

11-Fixed Levels

AC and DC Bounce

The TSG3 is a high quality source of a variety of linearity and modulated pedestal test signals. Variable APL may be combined with either of these signals for measurement of non-linear distortions. The TSG3 operates independently of all other Test Signal Modules installed in the 1410 Mainframe with its rear panel output available simultaneously with all other test signal module outputs. One of the Sync Pulse modules must be installed in the 1410 Mainframes to drive the TSG3.

The 5-step and 10-step staircase signals and the ramp signal can be selected with, or without, 180° subcarrier modulation. The subcarrier amplitude is front panel selectable at either 20 IRE or 40 IRE. Applications include measurements of differential phase and gain, dynamic gain, luminance linearity, and burst-phase errors.

The flat field signal can be used on all active picture lines with levels set by the IRE-level control, or flat field on four lines can be alternated with one line of linearity or modulated pedestal (90° subcarrier). When using an alternate mode, APL is controlled by the IRE-level control.

The AC bounce position of the IRE level switch provides a signal in which the active portion of each line (excluding sync) changes dc levels at a rate determined by the rate control. The amplitude of the bounce excursions is fixed at 0 to 100 IRE in flat field mode and 10% to 90% APL in alternate modes.

The DC bounce position of the switch causes the entire signal, including sync, to change dc levels at a rate determined by internal adjustments. The bounce excursion is the same as in the AC bounce mode.

The modulated pedestal is a unique, Tektronix-developed, chroma-step signal that provides a means for checking luminance signal distortion caused by the subcarrier signal (chrominance-luminance intermodulation). When modulated pedestal is selected by the 90° subcarrier switch, subcarrier, phased to lead burst by 90° is added to the pedestal lines, either one-level of 5 to 20 IRE subcarrier or as three-levels of 20-, 40- and 80-IRE subcarrier can be selected.

The three-level subcarrier is used to determine the effects of subcarrier rectification upon luminance signals at all APL's through the entire TV system.

Characteristics

Luminance Component—Peak amplitude: 714 mV ± 7.14 mV. 5 Step amplitude: 143 mV. 10 Step amplitude: 71.5 mV. Abberrations: within 2% of step amplitude. Step rise time: 250 ns ± 39 ns between steps within 1%.

180° Subcarrier Component—Absolute amplitudes: ± 3%. Relative amplitudes: ± 1%. 20 IRE: 143 mV ± 3%. 40 IRE: 285.7 mV ± 3%.

Subcarrier Envelope—Rise time: 400 ns ± 60 ns. Duration: 47.7 μs. Delay from Line Sync: 9.93 μs.

Differential Phase— 0.1° or less at 10%, 50%, and 90% APL.

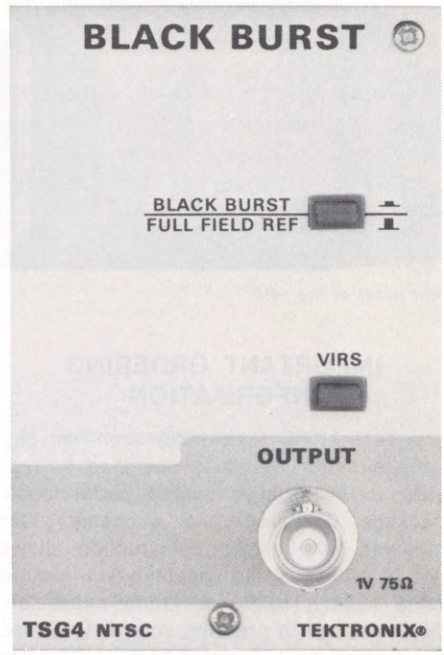
Differential Gain— 0.5% or less at 10%, 50%, and 90% APL.

Modulated Pedestal
90° Subcarrier

Amplitude

One Level— 5 to 20 IRE (internally adjustable)

3 Levels— 20, 40, and 80 IRE.



The TSG4 (actual size) is normally used only with the SPG3.

Black Burst

Vertical Interval Reference Signal

Field Reference Signal

The TSG4 Black Burst module is designed primarily for use with the SPG3 Sync Generator, the only sync generator in the 1410 Series that does not generate black burst. The TSG4 may also be used to generate a full field Vertical Interval Reference Signal.

Because of the VIR signal's obvious simplicity, it may be much easier to use for adjustment of a VTR's playback conditions and should be considered as a possible substitute for color bars on video tape leaders.

TSG4 may be used with SPG1 and SPG2 if both Black Burst and Full Field VIRS are needed.

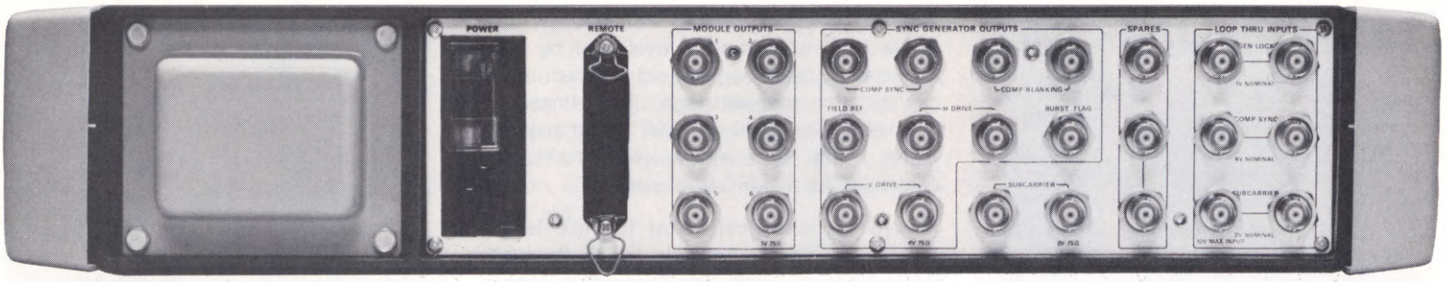
VIR Signal

Chrominance—Amplitude: 286 mV ± 2.86 mV (40 IRE ± 0.4 IRE). Phase: within 0.5° of burst. Envelope rise time: Sin^2 shaped, 1 μs ± 150 ns.

Luminance—Setup level: (7.5 IRE ± 0.5 IRE). Gray level: (50 IRE ± 0.5 IRE). Chroma pedestal: (70 IRE ± 0.7 IRE).

Black Burst

Sync Amplitude— (40 IRE ± 0.5 IRE).
Rise and Fall Time— 135 ns ± 15 ns.
Setup Level— (7.5 IRE ± 0.5 IRE).
Burst— (40 IRE ± 0.4 IRE).
Burst—Rise time 400 ns ± 60 ns.



Rear panel of the 1410

IMPORTANT ORDERING INFORMATION

The 1410 NTSC Sync Pulse and Test Signal Generator Series is designed to provide you with high quality performance, package flexibility, and economy. Our modular plug-in card construction allows you to order just the capability you require while leaving room for future expansion. To assist you in ordering your 1410 Series Generator, we recommend you follow the easy steps listed here.

1) Make your selection of the functions you need. Remember you have two mainframes, three sync pulse generators, and four test signal generators available in just about any combination you desire. Some typical packages are listed later in this section.

2) If you are ordering a 1410 Generator and one or more modules that you want delivered tested as a package, your purchase order must include "Option 88". **"Option 88" is our key to assemble, calibrate, and ship your 1410 Series Generators as a single unit package.**

If you already own a 1410 Generator and are adding functions to your package you need order only the module required. **Do not order Option 88 when adding modules to a 1410 Package you already own.**

For example, assume you do not own a 1410 Series Generator and you wish to order a full color sync generator with genlock. Your purchase order should read:

Order: 1410 Generator Option 88
SPG2 Genlock Sync Generator Option 88

If at a later date you needed to add a convergence signal and color bar signal, your purchase order should read:

Order: TSG1 Color Bars Generator
TSG2 Convergence Generator

3) If you are ordering more than one 1410 Generator package on the same purchase order, be sure to indicate the specific functions (modules) to be included in each package.

TYPICAL 1410 SYNC GENERATOR PACKAGES

1) Master sync generator without genlock and ±10 Hz color standard.

Order: 1410 Generator Option 88
SPG1 Sync Generator Option 88

2) Master sync generator without genlock and ±1 Hz color standard.

Order: 1410 Generator Option 1 Option 88
SPG1 Sync Generator Option 88

3) Master sync generator with genlock and ±10 Hz color standard.

Order: 1410 Generator Option 88
SPG2 Genlock Sync Generator Option 88

4) Master sync generator with genlock and ±1 Hz color standard.

Order: 1410 Generator Option 1 Option 88
SPG2 Sync Generator Option 88

Sync generators SPG1 and SPG2 come with a black burst signal. If an SPG3 is ordered and black burst is required, order a TSG4 Black Burst Module.

POSSIBLE 1410 TEST SIGNAL GENERATOR PACKAGES

1) Master sync generator with genlock, ±10 Hz color standard, color bars test signal, and linearity test signal.

Order: 1410 Generator Option 88
SPG2 Genlock Sync Generator Option 88
TSG1 Color Bars Generator Option 88
TSG3 Linearity Generator Option 88

2) Sync Generator (sync generator outputs not required), ±10 Hz color standard, color bar test signal, and convergence pattern signal.

Order: 1410 Generator Option 88
SPG3 Sync Generator Option 88
TSG1 Color Bars Generator Option 88
TSG2 Convergence Generator Option 88

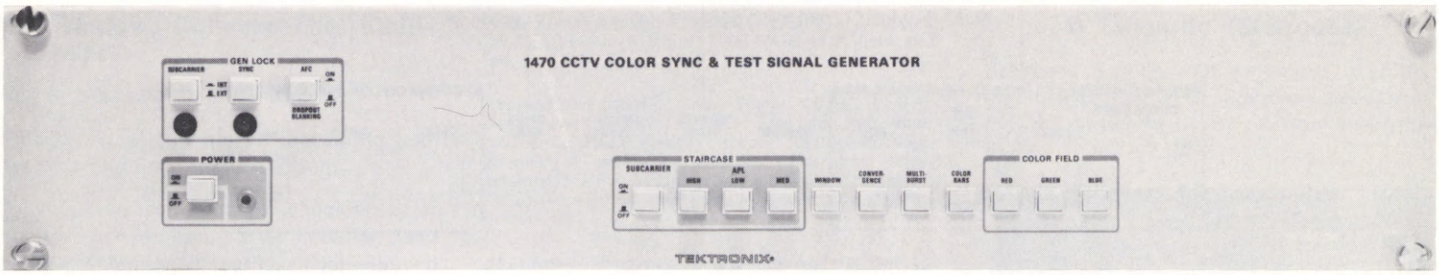
Of course there are many 1410 Test Signal Generator packages available. Choose the combination that best suits your needs. Remember that your Tektronix Television Field Engineer is available to advise you.

ORDERING INFORMATION

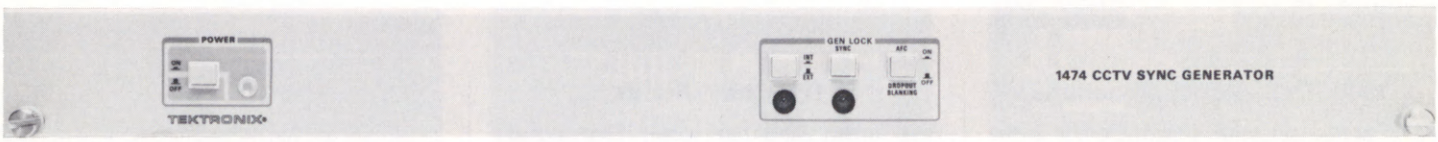
1410C Generator (cabinet)
1410C Generator (cabinet) Option 1 (1 Hz)
1410R Generator (rackmount)
1410R Generator (rackmount) Option 1 (1 Hz)
SPG1 Sync Generator
SPG2 Sync Generator
SPG3 Sync Generator
TSG1 Color Bars Generator
TSG2 Convergence Generator
TSG3 Linearity Generator
TSG4 Black Burst Generator

Optional Items—333-2162-00 Two-wide blank panel, 333-2171-00 One-wide blank panel.

Option 88 (test together as a package). This option line should be used with each item whenever you want your group of 1410 Series Generators delivered assembled and tested as a package.



1470 CCTV Color Sync and Test Signal Generator



1474 CCTV Color Sync Generator

1470 and 1474

Full Color Sync Generator with Genlock

Locks to Most Helical Scan VTRS

Simple to Operate

Compact and Economical

Sync and Timing Signals

- **Comp Sync**
- **Comp Blanking**
- **Vertical Drive**
- **Horizontal Drive**
- **Burst Gate**
- **Subcarrier**
- **Black Burst**

1470 Only

Test Signals

- **Comp Video**
- **Color Bars**
- **Staircase**
- **Window**
- **Convergence Pattern**
- **Multiburst**
- **Red Field**
- **Green Field**
- **Blue Field**

The 1470 CCTV Color Sync and Test Signal Generator is a compact, economical unit designed as a full color, gen-lock sync generator that also provides a selection of high quality full field test signals. The 1474 also is a full color, gen-lock sync generator identical in performance to 1470 but without test signals capability. Among the sync and timing features of the 1470 and 1474 is the ability to color gen-lock to composite video from all normal sources including most helical scan video tape recorders. Only 3.5 inches of rack height is used for the 1470. The 1474 is even more compact at 1.75 inches of rack height. Both generators are shipped ready to bolt into a 19 inch rack.

1470/1474 Sync-Pulse Generation

The sync-pulse functions of the 1470 and 1474, like those of other Tektronix generators, are of high quality. This generator can operate as a master-sync generator or as a unit fully or partially timed from external sources. Color Gen-Lock capable of locking to helical scan VTR's is a standard feature.

Front-panel push-button selection of external subcarrier and sync is provided for your convenience. If external subcarrier is lost, the 1470 starts monochrome operation automatically and a warning light appears. Loss of sync is indicated by a front panel warning light.

Sync Generator Outputs (1470/1474)

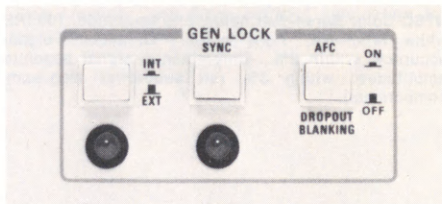
Composite Sync—Output level into 75 Ω: 4 V ±0.5V. Return loss: at least 30 dB to 5 MHz. Rise and fall time (10% to 90%): 140 ns ±15%.

Composite Blanking—Output level into 75 Ω: 4 V ±0.5V. Return loss: at least 30 dB to 5 MHz. Field blanking rise and fall time: 140 ns ±15%.

Vertical Drive—Output level into 75 Ω: 4 V ±0.5 V. Return loss: at least 30 dB to 5 MHz. Rise and fall time: 140 ns ±15%. Duration: 9 lines.

Horizontal Drive—Output level into 75 Ω: 4 V ±0.5 V. Return loss: at least 30 dB to 5 MHz. Rise and fall time: 140 ns ±15%. Duration: 6.35 μs ±5%.

Burst Gate—Output level into 75 Ω: 4 V ±0.5 V. Return loss: at least 30 dB to 5 MHz. Delay from line sync: 5.13 μs ±0.1 μs. Rise and fall time: 140 ns ±15%. Duration: 2.51 μs ±100 ns.

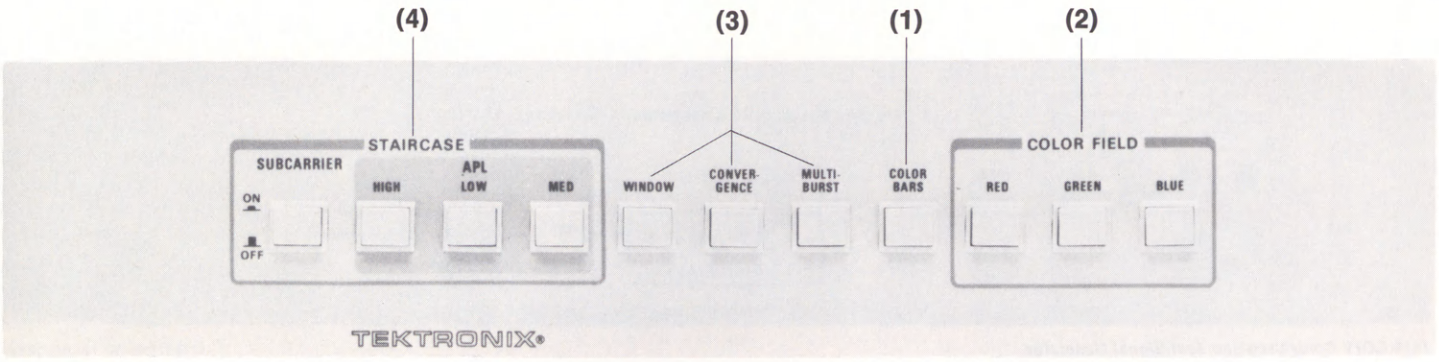


Sync Generator Controls (1470 and 1474)

Subcarrier—Output level into 75 Ω: 2 V ±0.2 V. Return loss: at least 30 dB to 5 MHz. Frequency: 3.579545 MHz ±10 Hz.

Black Burst—Sync amplitude into 75 Ω: 40 IRE ±1 IRE (286 mV). Burst amplitude: 40 IRE ±2 IRE (286 mV p-p). Burst frequency: 3.579545 MHz ±10 Hz. Return loss: at least 30 dB to 5 MHz.

Gen Lock Signal Loop Input—Composite video input range: 0.5 V to 1 V when loop-through connectors are externally terminated into 75 Ω.



Test signal controls

1470 Test Signal Functions

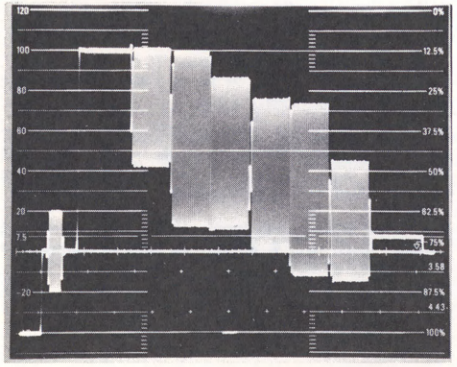
Push button selection of test signals in the 1470 simplies your test signal selection and speeds your testing operations. All test signal push buttons, with the exception of the color field selectors, are self cancelling.

Each test signal is of the highest standards of the industry, providing essentially aberration-free transitions and accurate flat levels. Specifications for the test signals may be found under Characteristics later in this section.

(1) Color Bars

The 1470 provides full field color bars of the highest quality. Colors bars are useful for color monitor adjustment, VTR tape lead in, and system checks.

NTSC Color Bars—Full field, 75% amplitude, 100 IRE white reference, 7.5% setup. Luminance signal accuracy: within 2%. Chrominance signal absolute amplitudes: within 3% (all subcarrier frequency components).

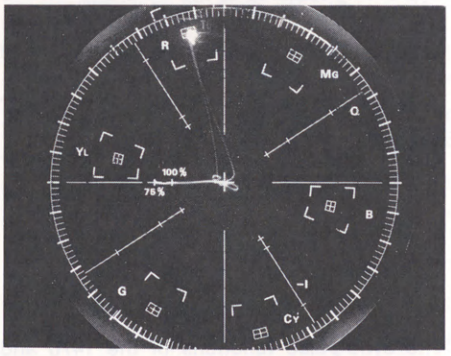


Full Field Color Bars.

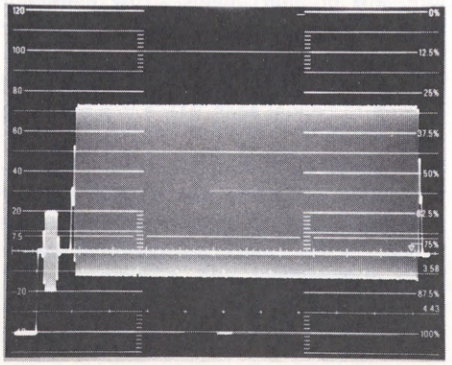
(2) Color Fields

Red, green, and blue color field signals for checking purity on color monitors receivers that do not have individual gun on/off controls. These signals may also be used to provide a color background source. The red, green, and blue selectors may be used simultaneously to provide yellow, cyan, magenta, and white full field signals.

Red

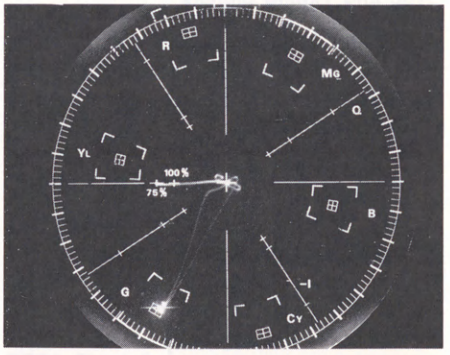


Red Field Vector.

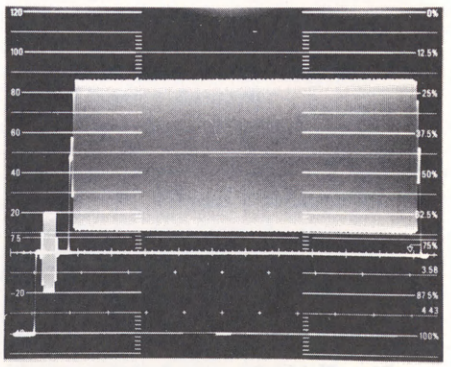


Red Field displayed at line rate.

Green



Green Field Vector.



Green Field displayed at line rate.

(3) Window, Convergence, Multiburst

Test Signals available include:

Window signal suitable for measuring both line time and field time distortion.

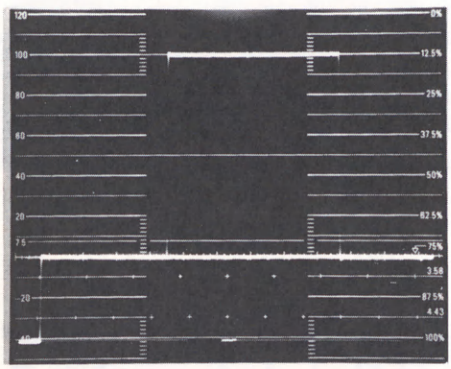
Convergence test signal for checking color monitor convergence and linearity, and camera scanning linearity. (Not Shown)

Multiburst signal for checking system frequency response.

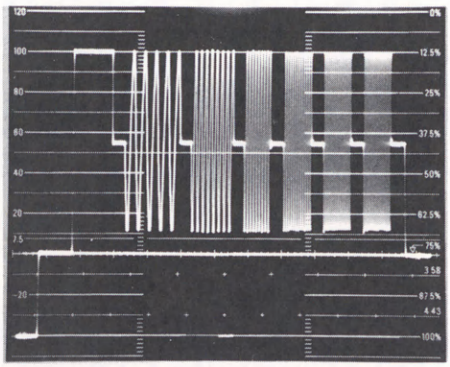
Window—Amplitude: 100 IRE ±2 IRE. Duration: 25.8 μs, ±3%. Starts at line 66 in each field and ends at 218 in each field. Rise time: 140 ns ±15%.

Crosshatch Pattern or Dots—Setup: 7.5 IRE ±1 IRE. Peak level: 77 IRE ±2 IRE. Rise and fall time: 140 ns ±10%. Vertical lines: polarity positive. Number of unblanked pulses-17. Horizontal lines: polarity positive. Number of unblanked pulses-14. Dots: located in same positions as crosshatch intersections.

Multiburst—White reference amplitude: 100 IRE ±2 IRE. Multiburst amplitude: 90 IRE ±3 IRE. Average level: 55 IRE ±1 IRE. Multiburst frequencies: 0.5 MHz, 1.5 MHz, 2.0 MHz, 3.0 MHz, 3.58 MHz, 4.2 MHz.

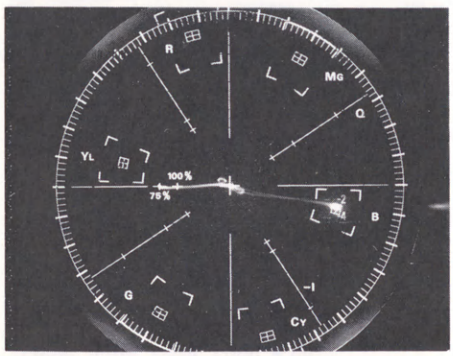


Window Signal.



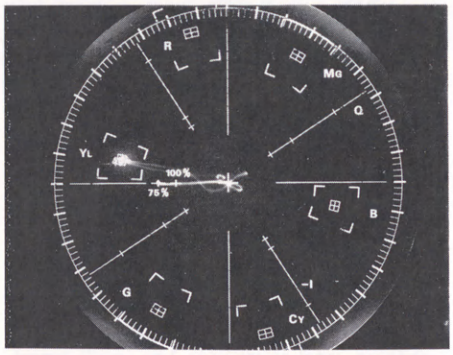
Multiburst—Note each burst stops and starts at the zero axis.

Blue

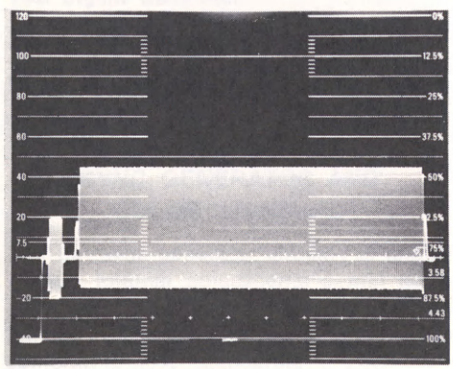


Blue Field Vector

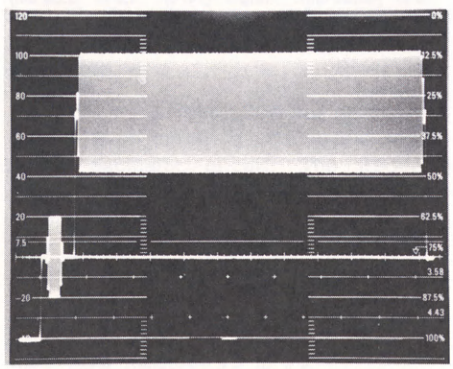
Yellow



Yellow Field Vector



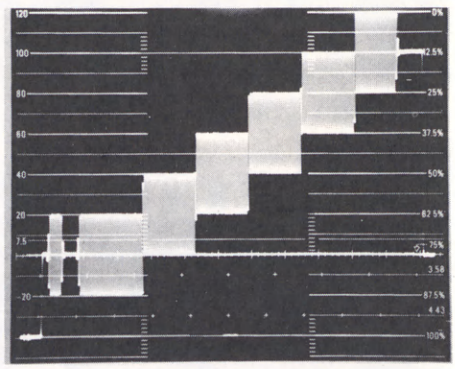
Blue Field displayed at line rate.



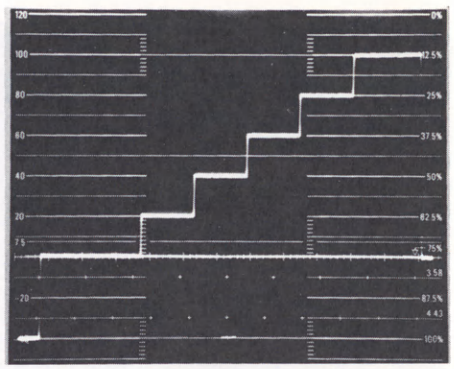
Yellow is formed by combining red and green fields.

(4) Linearity (Staircase)

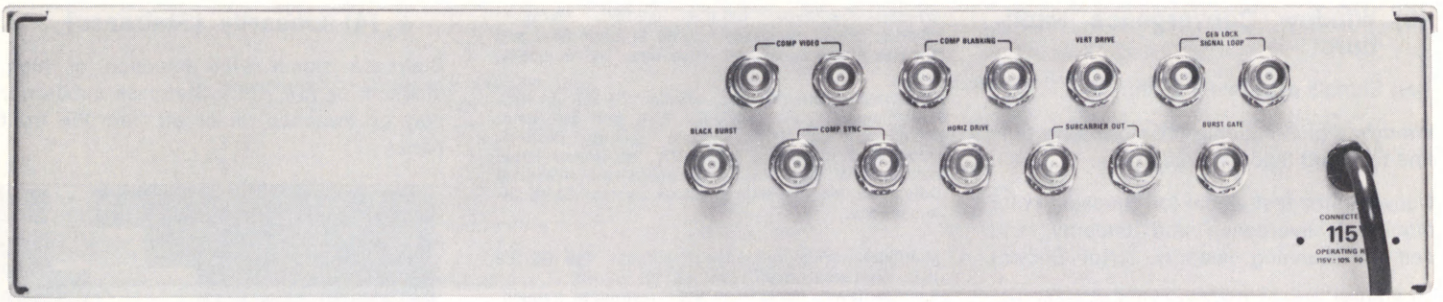
Staircase signal with selection of high, medium, or low APL. Staircase subcarrier may be switched on or off from the front panel.



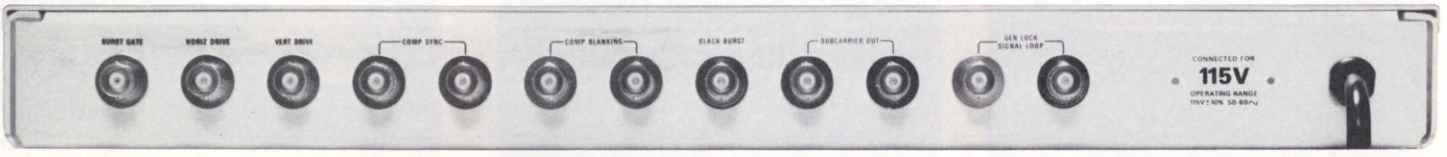
5-Step Modulated Linearity Test Signal for differential gain and phase measurements.



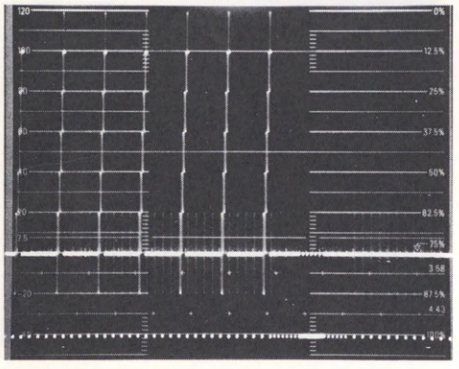
5-Step Linearity Test Signal without modulation for gray-scale evaluating gray scale tracking.



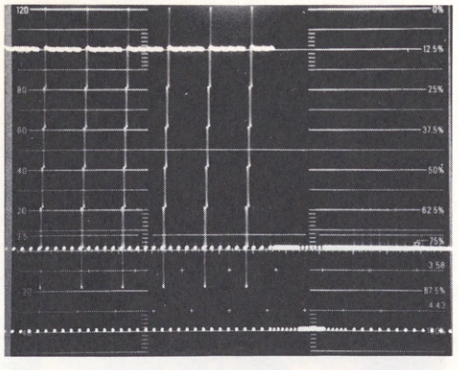
1470 Rear Panel



1474 Rear Panel



The Staircase Linearity Test Signal is useful in measuring non-linear distortions. Note four lines at O IRE alternated with a staircase line for tests at a low APL.



Four lines at 100 IRE alternated with a staircase line for tests at high APL.

Staircase Luminance Component— 5-step amplitude (each step): 20 IRE ±1 IRE (143 mV). Staircase amplitude: 100 IRE ±3 IRE (714 mV). Aberrations: within 2% of step amplitude. Step rise time: 150 ns ±15%.

Staircase Subcarrier Chrominance Component— Amplitude: 40 IRE ±1 IRE (286 mV p-p). Phase: 180°. Differential phase: 0.3° or less. Differential gain: 0.5% or less. Subcarrier envelope rise time: 400 ns ±15%.

1470 Test Signal Generator Outputs

Composite Video—Return loss: at least 30 dB to 5 MHz. Output level into 75 Ω: 1 V. Sync: 40 IRE ±1 IRE (286 mV nominal amplitude). Peak video level: +100 IRE ±2 IRE (714 mV nominal amplitude). Blanking dc level: 0 V ±50 mV.

Other Characteristics

Power Requirements— 115 V or 230 V Line Voltage; HI-LO Ranges. Selection switches for Line Voltages and Ranges are accessible internally. Factory set to 115 V. 115 V Range—HI: 108 V to 132 V, LO: 90 V to 110 V. 230 Range—HI: 216 V to 264 V, LO: 198 V to 242 V. Line Frequency: 50-60 Hz.

Dimensions—Length: 19.0 in (48.26 cm). Width: 19.0 in (48.26 cm). Height (1470): 3.5 in (8.89 cm). Height (1474): 1.75 in (4.45 cm).

ORDERING INFORMATION

1470 CCTV Color Sync and Test Signal Generator

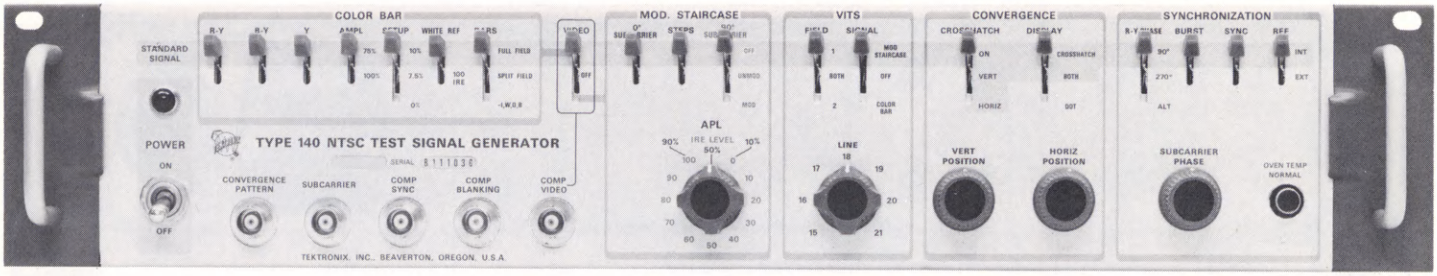
Option 1, Sync Generator Without Genlock

1474 CCTV Color Sync Generator

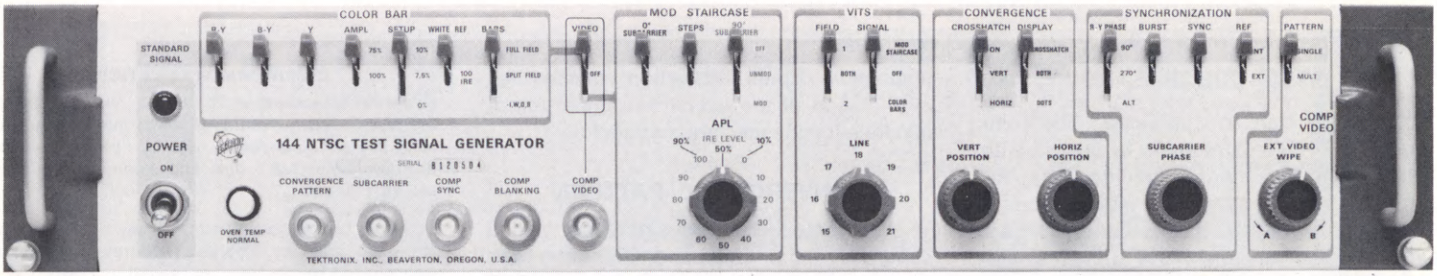
Option 1, Sync Generator Without Genlock

Rack Mounting—The 1470 and 1474 are shipped ready to install.

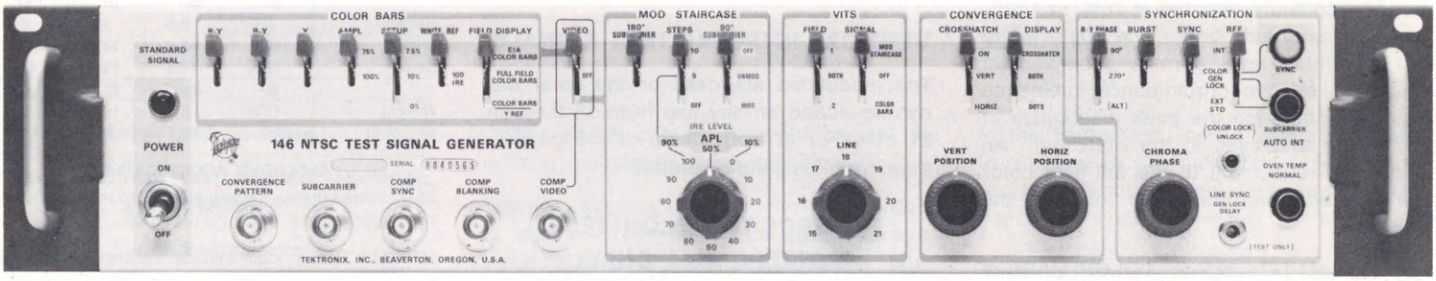
These units are master sync pulse generators and sources of test signals.



Rackmount version; cabinet version has carrying handle, less mounting hardware.



Rackmount version; cabinet version has carrying handle, less mounting hardware.



Rackmount version; cabinet version has carrying handle, less mounting hardware.

Master Sync Generator and Color Standard

Proportional Control Color Standard

Color Gen-Lock (146 Only)

Timing Jitter Less Than 4 ns

Test Signal Generator

NTSC Encoded Color Bars

Modulated Staircase

Convergence Pattern

SYNC GENERATOR AND COLOR STANDARD

The EIA sync generator circuitry is largely digital. Internal adjustments permit some variation of widths, including burst flag timing. These adjustments are preset to conform to FCC standards.

Color Gen-Lock (146 only), External Subcarrier, and Internal Subcarrier can be selected for color standard reference. The 146 NTSC Signal Generator can synchronize the time of occurrence of field, frame, line, and subcarrier from composite video input. Front-panel lamps indicate loss of gen-lock H sync and/or subcarrier due to excessive noise and/or low amplitude.

The color standard has a proportional control oven for the quartz crystal and the entire oscillator circuit. The frequency stability achieved is well within FCC specifications.

GEN-LOCK (146 only)

Input—Comp video or black burst, (sync negative).

Input Level Range— 0.5 V to 2 V.

Input Return Loss— 46 dB to 5 MHz.

Phase Accuracy—Within 1° input burst variations + or —10 Hz of 3.579545 MHz.

Within 5° with ambient temperature variation from 0°C to 50°C; within 1° for any 10°C variation within 0° to 50°. Burst must be 3.579545 MHz within 1 Hz and oven temperature normal.

Within 1° with input signal + or —3 dB from 1 V. Within 3° with burst/sync ratio variation —6 dB to +10 dB. Burst must be 3.579545 within 1 Hz, ambient temperature 20°C and oven temperature normal. Dynamic burst phase stability is within 0.1° with APL variation 10% to 90%; within 1° with —24 dB white noise.

Delay Range—Adjustable between 3 μs before input sync to 1 μs after. Delay is stable within 70 ns. Factory-set to coincidence.

Pull-In Time— 200 ms max.

Field/Frame Sync—Direct acting within one field.

The 146 will not gen-lock to helical scan VTR signals or monochrome derived sync (15,750 Hz line rate, 60 Hz field rate).

146 Rear Panel. The 140 and 144 do not have a gen-lock input but do have a comp sync input. In addition, the 144 has two 75 Ω loop through external video inputs.

NTSC COLOR BARS

NTSC color bars are provided. The composition of these signals is in accord with EIA color bar signal specifications RS 189. In addition to basic signal requirements, these 100% saturated color bars are provided in either 75% or 100% amplitude with a choice of 0%, 7½%, or 10% setup. The white bar amplitude may be independently selected at 75% or 100% for 75% amplitude bars. The 100% white bar amplitude level permits a convenient check of relative chrominance/luminance gain by comparing the peak amplitudes of the yellow and cyan to the white bar. An additional refinement to the full-field color bar is a black reference bar following the blue bar.

A new, split-field signal, COLOR BARS/Y REF (146 only), provides a picture monitor display and a waveform suitable for detecting the effects of rectified subcarrier on luminance (luminance cross-modulation).

STAIRCASE

The modulated staircase signal is provided with a selection of APL from 10% to 90% (0 to 100 IRE) in eleven equal levels, or at a fixed APL of 50%.

The staircase luminance component is either 10 equal, 10 IRE steps; 5 equal, 20 IRE steps; or OFF as selected by front-panel switch. The subcarrier component is phase-locked to color burst. The signal is in strict conformity with IEEE 206 and the definition of APL is rigorously observed.

MODULATED PEDESTAL

A unique, TEKTRONIX-developed, chroma-step signal provides a means to check luminance signal distortion caused by rectification of the subcarrier signal (chrominance-luminance intermodulation).

CONVERGENCE PATTERN

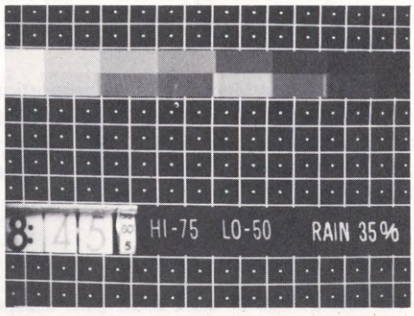
The convergence pattern signal is provided separately and independently from the other test signals. It conforms to IEEE standard 202.

VERTICAL INTERVAL TEST SIGNALS

The modulated staircase or the color bar can be added on any line from 15 through 21 of either or both fields of the generator's own test signal output.

COMPOSITE COLOR TEST PATTERN (144 ONLY)

This operating mode provides a convergence pattern (crosshatch lines and/or dots) with two insert areas. Each insert is digitally controlled from the sync generator. The user may select the lines to be included in each insert area by proper placement of insulated color-coded jumpers within the instrument.



Composite Color Test Pattern.

OTHER CHARACTERISTICS

Power Requirements— 90 to 136 Vac or 180 to 272 Vac, 48 Hz to 66 Hz, 55 watts max at 115 Vac and 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges. (Shipped set at 115 Vac.)

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0° to +50°C (except as noted).

Dimensions	Cabinet		Rack	
	in	cm	in	cm
Height	3½	8.9	3½	8.9
Width	16¾	42.6	19	48.3
Depth	18½	47.1	18½	47.1
	lb	kg	lb	kg
Weight	17¾	8.0	18½	8.4
Shipping	≈34	≈15.4	≈35	≈15.9

INCLUDED ACCESSORIES

75-Ω, through-line termination (011-0103-02); 3-conductor power cord (161-0036-00).

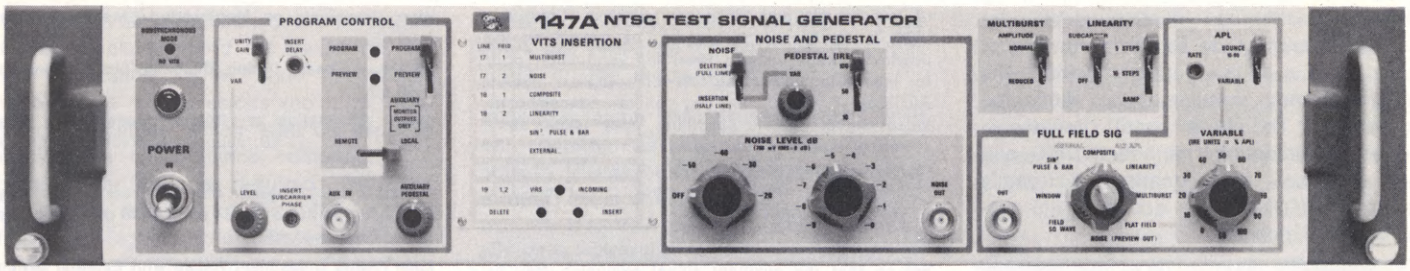
All R140 Series also include rackmounting hardware.

ORDERING INFORMATION

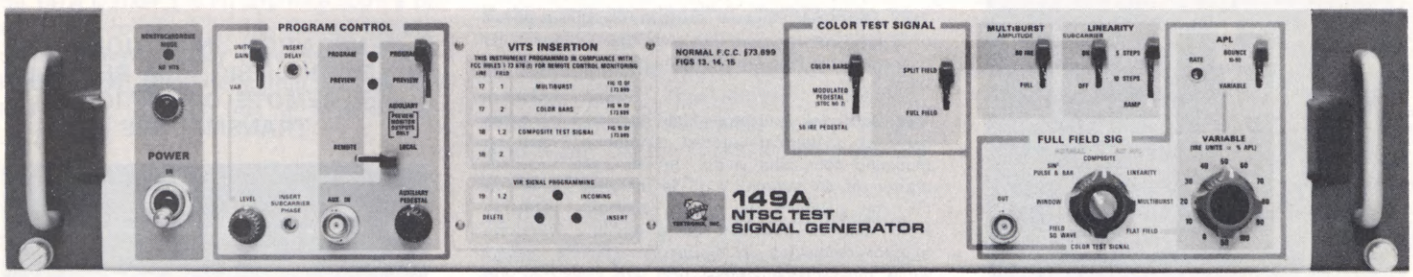
When ordering, please use the exact nomenclature as given here.

140 NTSC Signal Generator
R140 Signal Generator (rackmount)
144 NTSC Signal Generator
R144 NTSC Signal Generator (rackmount)
146 NTSC Signal Generator
R146 Signal Generator (rackmount)

The 147A and149A are similar NTSC television signal generators that supply all the test signals commonly used for test and measurement of video transmission systems.



Rackmount version; cabinet version has carrying handle less mounting hardware.



Rackmount version; cabinet version has carrying handle less mounting hardware.

147A/149A Features

Vertical Interval Test Signals-Generation, Insertion, and Deletion

Sync and Burst Regeneration

Program Signal Protected

Full-Field Test Signals Separate from VITS Program

Easily Reprogrammed for New Signals

Vertical Interval Reference Signal

147A Unique Features

Noise Test Signal

149A Unique Features

One Unit Source of Signals Required by FCC § 73-676 (f) For Transmitter Remoting

Color Bars (When Gen-Locked to a Program Signal)

The 147A and 149A are similar NTSC television signal generators that supply all the test signals commonly used for test and measurement of video transmission systems. The signals generated are available as full-field composite-video test signals and as Vertical Interval Test Signals (VITS) which can be inserted on an incoming composite-video signal.

Timing information for VIT insertion is derived from the incoming composite video signal. There are extensive provisions within the instrument to modify the parameters of the test signals and their time location within the vertical blanking interval. This flexibility is provided through the use of easily-changeable pin connectors. All time locations of test signals, as to position within the line and field, are derived by digital counting from a master clock which in turn is gen-locked to the incoming synchronizing pulses; however, in the absence of incoming composite video (or sync), the generators will operate in the full-field test signal mode, deriving timing information from its own internal oscillator (clock).

VERTICAL INTERVAL INSERTION/ DELETION and PROGRAM CONTROL

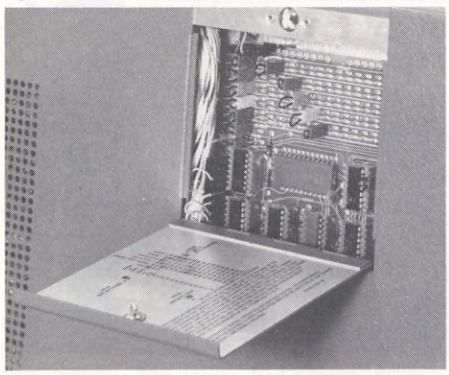
The 147A and 149A will insert VITS only when gen-locked to an incoming composite video signal. As a VITS deleter/ inserter function involves active circuit elements in the program line within the generator, fail-safe means are provided in the event of a malfunction within the instrument, loss of sync or power. In addition to the automatic fail-safe protection, remote-control manual override capability is also provided.

Black burst synchronization can be selected by a remotely controlled relay. When black burst is selected, the 147A and 149A automatically go to bypass operation. Internal reprogramming cannot defeat this function.

When incoming program is lost, the 147A and 149A will go to one of two operating modes selectable by internal reprogramming jumpers: (a) bypass, (b) by jumper selector, either a full-field test signal or a flat-field signal will appear at the program line output connector. In the event the program signal is lost, the transmitter will continue on the air.

A preview function allows observation of exactly what lines will be deleted and exactly what signals and levels will be inserted on the program signal before anything is done to the program signal itself. The preview/program function can be remotely controlled.

Changes in the time location of VIT signals are readily made by removing and/or moving color-coded jumpers within the generator. Any signal may be eliminated or moved. The front panel provides a means of indicating the actual VITS and their line and field location. Externally generated VITS may be added to the program line if desired.



Access is provided to the signal programming area. The generator is easy to reprogram when necessary for your signal needs.

PROGRAM CONTROL FEATURES

Processing Amplifier—In addition to performing deletion and insertion functions, the 147A and 149A amplifiers are designed to function as a processing amplifier.

The 147A sync and burst regeneration operating modes may be jumper selected as follows: (a) off, (b) monochrome signal—sync and burst regeneration inhibited, (c) monochrome signal—sync regeneration only. When in the proc amp mode, the 147A and 149A will not delete incoming VITS except when the 147A and 149A VITS programming takes priority.

Nonsynchronous Operation—Warning light indicates absence of incoming synchronizing information without which VITS deletion or insertion is automatically discontinued.

Program Level—Switch selects whether a preset gain, normally adjusted for unity gain between program input and program output, is used or whether a front panel level adjustment is available to normalize incoming signal to provide 1 volt at the program output.

Local-Remote Control of Program or Preview—Switch shift control of program or preview modes from front panel (local) to a remote position, controllable by connection of a remote switching circuit to a rear panel connector. When operating under local or remote control, a light indicates preview or program status, since the switch position may not indicate the actual operating mode.

Program-Preview-Auxiliary—This switch selects one of three modes: Program—VITS inserted on program line output according to internal selection of test signals and their time address. Preview—VITS inserted only on program as viewed on the preview monitor output; used for verification prior to impressing these signals on program output. Auxiliary—Permits the use of a noncomposite video signal at the auxiliary input (such as a sweep generator). This signal then appears at the monitor output connector, with composite blanking and with sync added. This mode is not available by remote control.

Auxiliary Pedestal—This control provides a dc offset so that the auxiliary signal excursion may be positioned between the black and white limits of the resulting composite video signal.

VITS Subcarrier Phase—This control adjusts phase of color subcarrier on internally generated signals to be correct in relation to the phase of incoming burst.

VIRS Incoming Indicator—Light indicates the presence of a Vertical Interval Reference Signal on incoming composite video. In this case, the generation of an internal VIRS is inhibited (inhibition may be disabled by remote control). Incoming VIRS can be observed on a suitable waveform monitor connected to the preview monitor output while internally-generated VIRS are added to the opposite field. Such displays easily detect small errors in the incoming VIRS.

PROGRAM CONTROL SYSTEM SPECIFICATIONS

Input Level—Adjusted to Unity Gain.

Variable Input Level— ±30%.

Input Return Loss—Less than 46 dB to 5 MHz. Power on, 40 dB to 5 MHz in bypass.

Output DC Level—Less than 50 mV (no signal).

Isolation Between Program and Program Monitor Outputs—Greater than 34 dB.

Inserted Signal Level— 714 mV (100 IRE) ±1%.

Frequency Response, Program, and Preview Channels— ±1%, 50 kHz to 5 MHz; +1%, —5%, 5 MHz to 8 MHz.

2 T Pulse to Bar Ratio— 100% ±0.5%.

Field Rate Squarewave Tilt—Less than 0.5%.

Line Tilt—Less than 0.5%.

Differential Phase at any APL, Standard Input—Program output less than 0.15%. Preview output less than 0.3%.

Differential Gain at any APL, Standard Input—Program output less than 0.2%. Preview output less than 0.4%.

Line Time Amplitude Nonlinearity—Less than 0.5%.

Random Noise Output Program Channel—Less than —75 dB RMS.

Residual Subcarrier on Noninserted Lines—Less than —60 dB p-p.

Hum, Transients on Noninserted Lines—Less than —60 dB.

Spurious Signals During Blanking Time—Less than —40 dB.

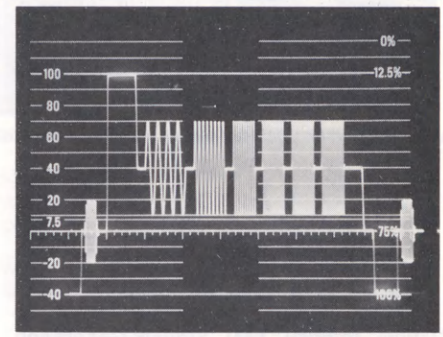
Signal Attenuation in "Delete" Mode— 2 T pulse greater than —70 dB; subcarrier (color bars) greater than —60 dB.

Crosstalk into Program Channel from Internal Signals— 2 T pulse less than —70 dB, subcarrier (color bars) —60 dB.

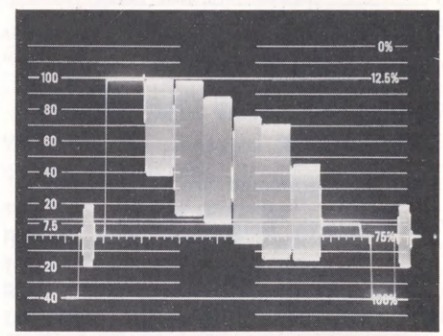
Line Timing Adjustment Range with External Sync— ±0.5 μs.

Jitter—Less than 5 ns.

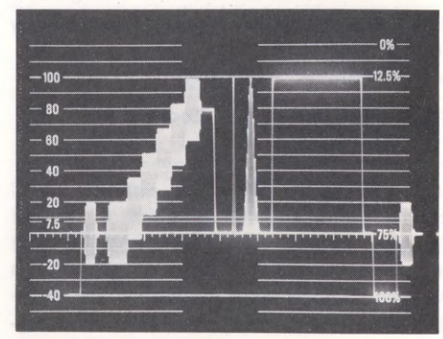
GENERATION, INSERTION, and DELETION of SIGNALS REQUIRED for REMOTE OPERATION of TRANSMITTERS



Multiburst Per FCC § 73.699



Color Bars Per FCC § 73.699



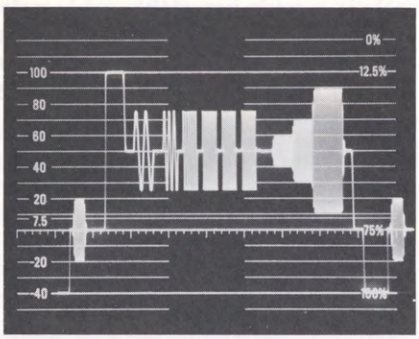
Composite Test Signal Per FCC § 73.699

The **149A** is an excellent, one unit source of the signals required for transmitter remote operation. The 149A recognizes monochrome transmissions (no burst) and includes facilities which may be used to squelch the chrominance components of the color bar signal as required. The 149A has all the features of the 147A, except Noise Test Signal. Color bars are available as VIT Line 17, Field 2, and as a Full-Field signal.

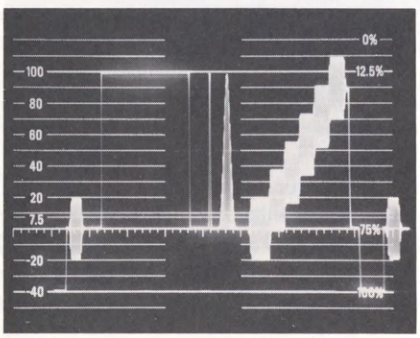
The **147A Option 1** is an alternate source of the signals required for transmitter remote control, however **Color Bars must be provided from an alternate** source such as the TEKTRONIX 140, 144, 146, or 1410, SPG2, TSG1.

INTERNATIONAL TEST SIGNALS

The **149A Option 1** is factory programmed to provide the two International Insertion Test Signals (ITS) for 525 line/60 field systems. The signals are inserted on line 17, fields 1 and 2.



Line 17, Field 1. (149 OPTION 1 ONLY)



Line 17, Field 2. (149 OPTION 1 ONLY)

VERTICAL INTERVAL REFERENCE SIGNAL

The VIR Signal is generated and inserted by the generator on line 19 of both fields. The generator has been designed to be programmable for a number of possible operating modes, which in turn depend upon the presence or absence of a VIR signal on the incoming program line.

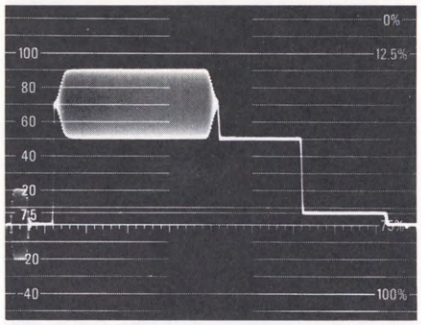
Indicator lamps indicate the presence of an incoming VIR signal, whether an incoming VIR is being deleted and whether a local VIR is being inserted. Remote control of the VIR signal functions is also available, with the indicators showing the actual operating mode. In the absence of burst, no VIR signal will be inserted.

If the program signal is monochrome, the 147A and 149A may be programmed (internal jumper) to either stop or continue inserting VIRS. This feature is useful if VIRS dependent automatic correction devices such as the TEKTRONIX 1440 are being used.

Amplitude—Within ±1 IRE of white reference.

Number of White Lines—57 through 227 on each field, all remaining active lines are black.

Rise Time—Shaped by $\sin^2$ filter with first zero in frequency domain at 4 MHz.



The Vertical Interval Reference Signal.

FIELD SQUAREWAVE

A sensitive measurement of field time distortion can be made with this signal. In this mode, the 147A and 149A provide a composite video signal with 170 active lines at 100 IRE, which approximates a 60 Hz squarewave. A composite video signal such as this reveals low-frequency phase and gain distortions much as a simple 60 Hz squarewave will do, but unlike the latter, it can pass through clamper amplifiers.

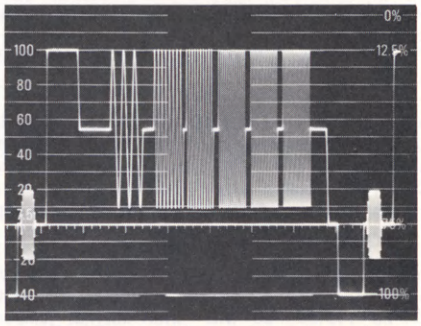
MULTIBURST SIGNAL

Multiburst is generated by a function generator controlled by the digital programmer. The function generator approach eliminates the need for individual start-stop oscillators for each burst and individual amplitude and AC axis adjustments for each burst. Thus each burst start time is completely stable and each burst consists of an exact integer number of cycles, regardless of the frequency. Each burst starts at 0° of the first cycle and ends at 360° of the last cycle. Location of the white flag may be programmed with relation to the bursts as a means of source identification.

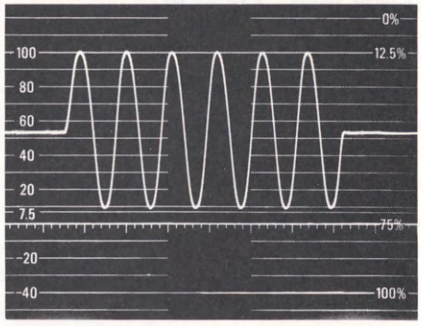
White Reference Amplitude— 100 IRE ±1 IRE.

Burst Amplitude—Normal amplitude: 90 IRE plus 10 IRE setup. Reduce amplitude: 60 IRE plus 10 IRE setup or 50 IRE plus no setup.

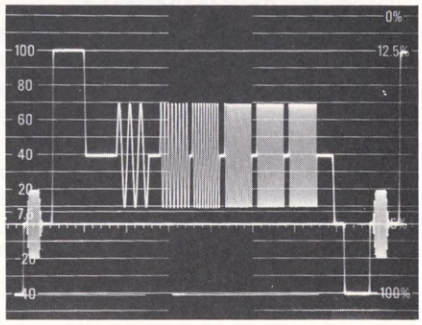
Average Burst Level— 55 ±1 IRE with 10% setup; reduced, 40 ±1 IRE.



Full Amplitude Multiburst with white and black flags.



Digital programming produces jitter-free, whole number of cycles of each burst.



50% Amplitude Multiburst for use where 100% tests are invalidated by nonlinear distortion; e.g., transmitters.

LINEARITY SIGNAL

Linearity—Three linearity test signals are front panel selectable: 5 step, 10 step, and ramp either modulated or unmodulated. Luminance component is either 10 equal 10-IRE step, 5 equal 16-IRE steps, or a 100-IRE ramp, selected by front-panel switch. Each of these is internally adjustable from 80-100-IRE peak amplitude. The subcarrier component is phase-locked to color burst. Applications include measurements of differential gain and phase, dynamic gain, luminance signal linearity, luminance signal distortion caused by chrominance signal nonlinearity, and burst-phase errors.

Measurements of differential phase and gain can be made more easily with 40-IRE subcarrier to override noise than with 20-IRE subcarrier. Subcarrier amplitude can be varied from 20 to 40 IRE by internal selection. Since this level of subcarrier should not be used together with full amplitude staircase or ramp where the test signal may be radiated, luminance amplitude of modulated linearity signals can be reduced to 80 IRE by internal adjustment.

Luminance Component—Peak amplitude 100 IRE within 1%. Each step is 20 IRE, within 1%, in 5 step and 10 IRE in 10 step. Step rise time is approx 230 ns and aberrations are within 2%. Step durations are 6 μs for 5 steps and 3 μs for 10 steps.

Chrominance Component—Amplitude is 286 mV p-p (40 IRE) within 5% and in phase with burst (can be 143 mV 20 IRE with internal jumper change).

Differential Phase— 0.2° or less.

Differential Gain— 0.5% or less.

Subcarrier Envelope—Rise time is approx 375 ns.

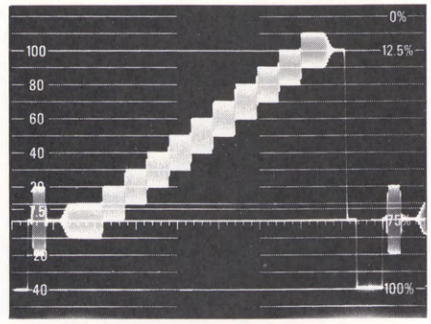
Ramp Luminance Amplitude— 714 mV, 100 IRE ±1%.

Ramp Linearity—Within 1%.

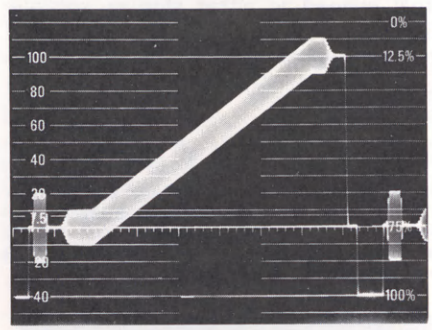
Ramp Duration— 30 μs.

Color Bars (149A Only)

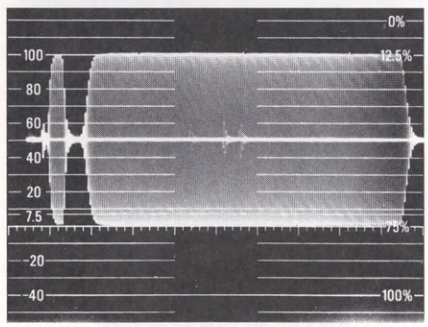
The 149A, when gen locked to a program signal, provides a unique luminance only/color-bar split-field signal selectable by a front panel switch. This split-field signal is useful to show gray scale tracking and consists of the luminance component of color bars on all active lines. The chrominance component is added to lines 66 through 218.



Linearity Test Signal — 10 step with 20 IRE subcarrier at burst phase.



Linearily Test Signal Ramp-0 to 100 IRE with 20 IRE subcarrier in phase with burst.



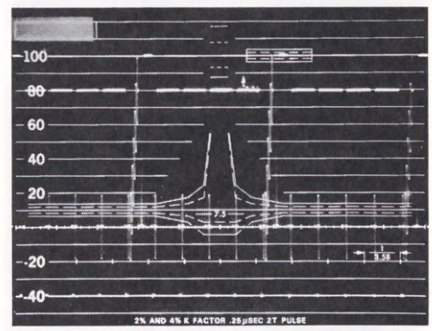
40 IRE, subcarrier, 5 step linearity test signal displayed in high-pass mode. Note the lack of significant transients at step transitions.

FLAT-FIELD SIGNAL

The Flat-Field Signal is used primarily for variable average picture level (APL) vertical interval testing. The Flat-Field Signal is a composite video signal which during the active portion of each field has a constant luminance level. During the vertical interval there will be present each test signal which has been programmed for insertion as described in the Vertical Interval Insertion/Deletion section.

The luminance level of the Flat-Field Signal is selectable in 10 IRE unit increments from 0 to 100 IRE. An alternate selection provides a "bounce" between 10 and 90 IRE at a 0.1 to 1.0 Hz rate. Thus the use of the Flat-Field Signal permits the use of the several test signals in the presence of a selectable APL. This technique is useful in the measurement of APL-dependent distortions.

An added feature provides a combined flat field and one selectable other test signal, i.e., color bar (149A only), multiburst, pulse and bar, linearity and composite. This mixed test signal provides a brighter waveform monitor display by



The new mixed test signal for APL testing consisting of four lines of variable flat field with one selectabe other test signal.

alternating four lines of the variable flat-field pedestal with one line of the selected other test signal during each active field.

Luminance Level of the Flat-Field Signal—Within 2% of the indicated level except the 100 IRE level which is within 1%.

Rise Time—Shaped by $\sin^2$ filter with first zero in the frequency domain at 4 MHz.

PULSE AND BAR SIGNAL

2 T, T pulses are generated to high precision by two 9 pole Kastelein filters. The digital programmer provides the high degree of timing accuracy required in these pulses to eliminate jitter and long term drift. The programmer also exactly determines pulse-to-pulse spacing and bar duration. However, the programmer may be readily reprogrammed to produce different spacings or bar widths in 2 μs increments.

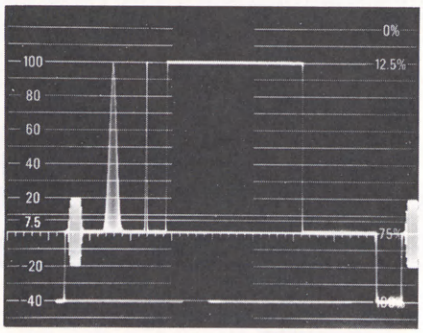
The $\sin^2$ pulse may be either 2 T (0.25 μs HAD) or T (0.125 μs HAD). The transitions of the bar are controlled by either of two Kastelein filters so that frequency spectrum is limited to 4 MHz or 8 MHz. Shape of these transitions is integrated $\sin^2$.

For a specific application, the user may elect to program the 147A for any combination of T or 2 T pulse and T or 2 T bar. As shipped, the pulse is 2 T, the bar is formed by the T filter. This provides for K factor measurements of short time distortion. Thus the pulse and bar test signal is useful to measure line time and short time distortions.

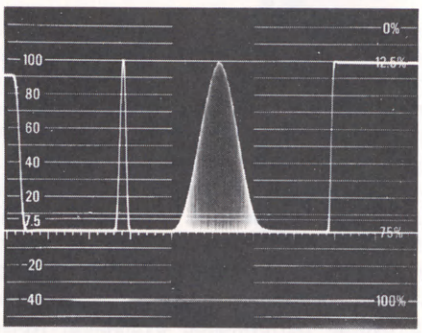
The envelope of the modulated $\sin^2$ pulse is formed in the function generator rather than in a filter. The function generator can be readily programmed for any desired pulse width from 1.5 to 2.5 μs. Thus the generator offers unique modulated $\sin^2$ pulse generator flexibility.

Modulated $\sin^2$ pulse (12.5 T) is used in measuring relative gain and delay errors between chrominance and luminance signals. The 12.5 T modulated $\sin^2$ pulse is extremely sensitive to delay distortion and easily utilized as delay distortion equals 10 d, where d equals baseline sinusoidal ripple in percent. The 20 T pulse is also available.

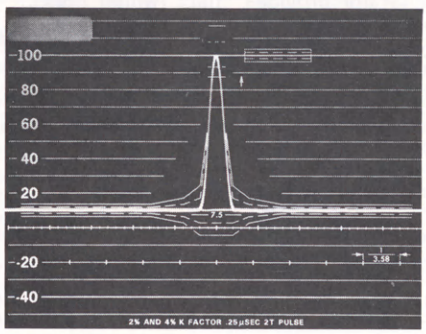
As a full-field test signal, the subcarrier component of the modulated $\sin^2$ pulse is phase modulated. The subcarrier could be free running, however, it could slowly drift in frequency in a manner annoying to the user. The frequency locked, phase modulated approach assures a stable display. When used as a VIT signal, neither field rate phase modulation nor frequency offsetting has utility. In the generator, a programmable phase offset between burst and the subcarrier component of the modulated $\sin^2$ pulse is provided. This conveniently source-codes the point in the system where the VIT signals are inserted. This subcarrier component may be viewed on either a vectorscope display or on most color monitors.



2 T pulse with 12.5 T modulated pulse and bar.



2 T pulse with 12.5 T modulated pulse and bar. Subcarrier is phase modulated at field rate.



2 T pulse with T Bar double exposed.

2 T Pulse Amplitude—Within 1 IRE of T Bar.

2 T HAD— 250 ns within 7.5 ns.

2 T Ringing—Amplitude less than 0.5 IRE; duration less than 4 cycles.

Time Location—Internally programmable in 2 μs increments.

T Bar Amplitude— 714 mV (100 IRE) ±1%.

T Bar Rise Time— 115 ns ±15%.

T Bar Time Location—Start and Stop internally programmable in 2 μs increments.

12.5 T Modulated Pulse Peak Chrominance to Peak Luminance Amplitude Difference—Less than 0.5 IRE.

12.5 T Modulated Pulse HAD — 1.57 μs or can be internally set to 2.5 μs 20 T, if desired.

T Modulated $\sin^2$ Pulse Residual Subcarrier—Less than 0.5 IRE on insertion line.

T Modulatd $\sin^2$ Pulse Relative Chroma-Luminance Time Delay—Less than 10 ns.

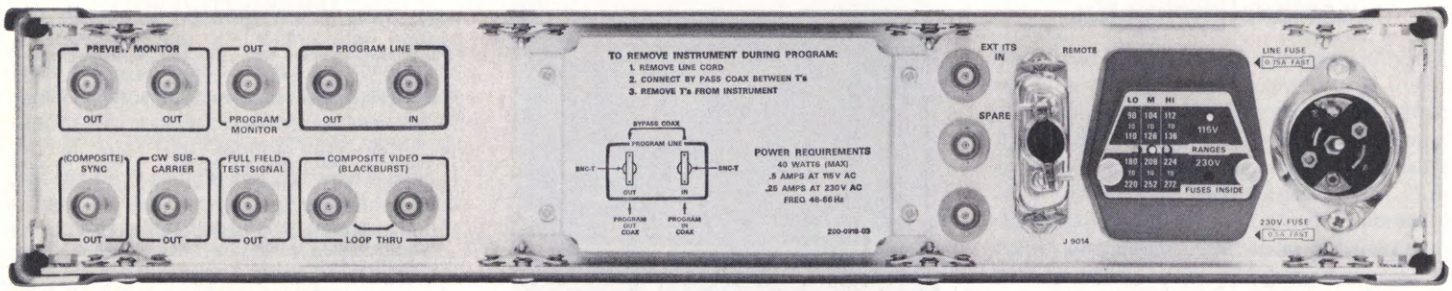
WINDOW SIGNAL

The Window Signal is the same as the Pulse and Bar except that the "Window" occupies lines 66 through 218 only. A window signal can be used to measure both line time and field time distortions. It is especially useful when observing picture monitors. Where field rate distortion is present, the window signal will be affected to a much greater extent than the pulse and bar signal.

Amplitude— 100 IRE within 1 IRE.

Rise Time—Internally programmable: either 2 T pulse and T Bar or T pulse and 2 T bar.

Window Duration—Lines 66 through 218.



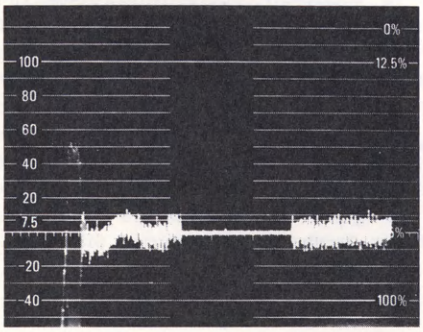
147A and 149A Rear Panel

COMPOSITE TEST SIGNAL

A composite test signal is attractive as a multiple function signal for either VIT use, where the whole signal occupies only one line per frame, or as a full-field signal which may be distributed throughout the entire plant on only one cable, with obvious economic advantage. The composite signal can be programmed in a variety of ways. Phase of the subcarrier of the modulated 20 T pulse may identify the signal insertion point.

NOISE TEST SIGNAL (147A only)

The 147A offers a unique signal-to-noise measuring technique for "in-service" testing during the vertical interval. The noise present in the middle portion of a line is deleted and noise generated in a calibrated source is inserted for measurement by comparision. The user varies a calibrated attenuator until inserted noise and incoming noise appear the same on a waveform monitor. The noise values measured are independent of operator interpretation errors to within 2 dB.



Noise test with inserted noise in center of line. Inserted noise is adjusted low for identification of time location. 147A only.

Where transmission noise is to be measured, the noise may be deleted on an entire line at the point from which the noise is to be measured using one 147A. Further down the transmission system, a second 147A will match the noise level in the manner described previously. This process may be repeated and the transmission noise level determined for several sections of the transmission system, or its overall performance evaluated. Noise may be measured at 10, 50, or 100 IRE luminance levels. The calibrated noise generator provides "flat" (white) noise.

External filters are required with the 147A when making noise measurements.

Noise Pedestal Amplitude—Selectable 10, 50, or 100 IRE within 0.2 dB.

Variable Pedestal—Provided.

Noise Levels— —20 dB to —59 dB in 1 dB steps (0 dB = 700 mV RMS).

Flat Noise Spectrum—Energy unit bandwidth: 15 kHz to 5 MHz ±6 dB. (Spectrum extends well beyond 5 MHz.)

Output Impedance— 75 Ω.

Return Loss—Less than —30 dB to 5 MHz.

Important—External filters are required.

OTHER CHARACTERISTICS

Power Requirements— 90 to 136 Vac or 180 to 272 Vac, 48 Hz to 66 Hz, 40 watts max at 115 Vac and 60 Hz. Rear-panel selector provides rapid accommodation for 6 line-voltage ranges. (Shipped set at 115 Vac.)

Inputs—External VITS Inputs, Program Input, Auxiliary Input, Composite Sync, and Subcarrier.

Output—Program Monitor, Preview Monitor (two each), and Full Field.

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0° to +50°C.

Dimensions and Weights

The 147A or 149A cabinet height is 3⅞ in or 9.9 cm; width is 17⅞ in or 45.5 cm; depth is 17⅞ in or 43.6 cm. Net weight is 19 lbs or 8.9 kg. Domestic shipping weight is 35 lbs or 15.9 kg. Export-packed weight is 55 lbs or 25 kg.

The 147A or 149A rackmount height is 3½ in or 8.9 cm; width is 19 in or 48.3 cm. Net weight is 20 lbs or 9.1 kg. Domestic shipping weight is 36 lbs or 16.3 kg. Export-packed weight is 56 lbs or 25.4 kg.

INCLUDED ACCESSORIES

75 Ω, BNC termination (011-0103-02); 2 each BNC-T adapters (103-0030-00); 7½ ft power cable, three wire (161-0036-00); VIT program clear plastic cover plate (200-1474-00); Front panel protective cover (200-1328-00); R147A and R149A includes rackmounting hardware.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

147A NTSC Signal Generator
147A NTSC Signal Generator (rackmount)
147A Option 1 NTSC Signal Generator
R147A Option 1 NTSC Signal Generator (rackmount)
149A NTSC Signal Generator
R149A NTSC Signal Generator (rackmount)
149A Option 1 NTSC Signal Generator
R149A Option 1 NTSC Signal Generator (rackmount)

NOISE MEASUREMENT FILTERS

External filters are required with the 147A Generator when making noise measurements.

For systems using 525/60 standards order 015-0212-00 Low Pass Filter and 015-0214-00 Noise Weighting Filter.

Order 015-0212-00 Low-Pass 4.2 MHz 525/60
Order 015-0214-00 Noise-Weighting 4.2 MHz 525/60

PAL AND PAL-M SIGNAL GENERATORS

TEKTRONIX Television Signal Generators are compact sources of high-quality test and synchronizing signals. All signals needed to time and accurately test, evaluate and adjust PAL broadcast and closed circuit color video equipment are provided. The information on this page is an overview intended to guide you to the best generator for your needs. Final selection should be based on the detailed information on the following pages. All generators have rack and cabinet versions.

Sync and Timing Signals.

	Pal		Pal-M	
Sync & Timing	**141A**	**145**	**142**	**145M**
Composite Sync	●	●	●	●
Composite Blanking	●	●	●	●
Subcarrier	●	●	●	●
Burst Flag	●	●	●	●
PAL Pulse	●	●	●	●
Line Drive	●	●	●	●
Field Drive	●	●	●	●
1 MHz Reference	●	●		
25 Hz	●	●		
12.5 Hz	●	●		
30 Hz				●
15 Hz				●

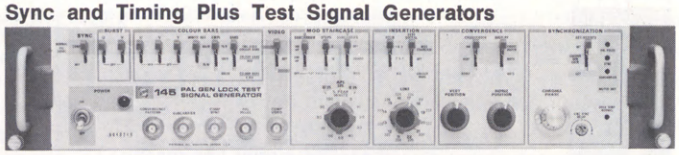
Test Signals

	Pal			Pal-M		
Signal	**141A**	**145**	**148**	**142**	**145-M**	**148-M**
EBU Color Bars	●	●				
Color Bars				●	●	
Color Bars/Luminance Reference		●			●	
Color Bars/Red Reference		●			●	
Modulated 5 Step Staircase	●	●	●●	●	●	●●
Modulated 10 Step Staircase		●	●●	●	●	●●
Modulated Ramp			●●			●●
Modulated Pedestal		●		●	●	
Multiburst			●●			●●
Sin^2 Pulse and Bar			●●			●●
Field Square Wave			●			●
Flat Field			●			●
APL Bounce			●			●
Noise Measuring Capability			●●			ITS ONLY
Convergence Signal	Option 1	●		●	●	
ITS, International Per EBU						
Line 17			●●			
Line 18			●●			
Line 330			●●			
Line 331			●●			
CCIR-I						●●
CCIR-II						●●
SIG-III						●●

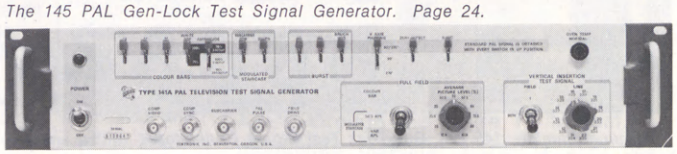
Signals are not necessarily simultaneous and a few require simple reprogramming.

● Full Field only ●● ITS plus Full Field

Sync and Timing Plus Test Signal Generators

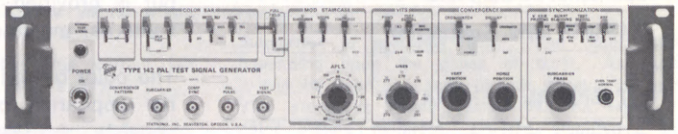


The 145 PAL Gen-Lock Test Signal Generator. Page 24.



The 141A PAL Test Signal Generator. Page 27.

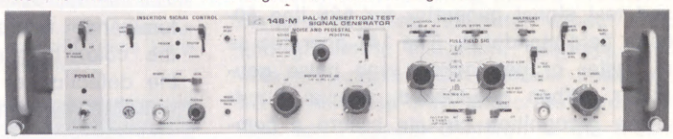
The 145-M PAL-M Gen-Lock Test Signal Generator. Page 33.



The 142 PAL-M Test Signal Generator. Page 37.

Insertion Test Signal Generators

The 148 PAL Insertion Test Signal Generator. Page 28.



The 148-M PAL-M Insertion Test Signal Generator. Page 38.

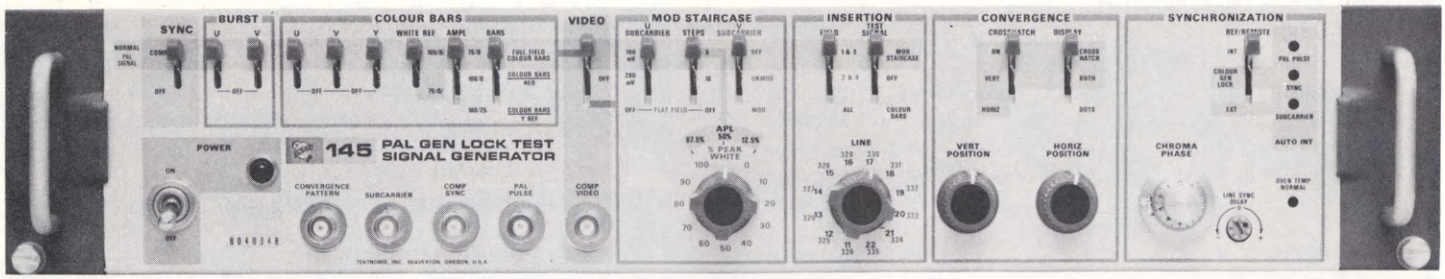
Timing Signals—The 148 and 148-M have composite sync and subcarrier outputs when gen-locked.

Special Purpose Generators

The 1430 Random Noise Test Generator. Page 41.

The 1461 Insertion Test Signal Generator (ITS Lines 17 and 330). Page 47. (Automatic Correctors)

This unit is a color gen-lock, master sync pulse generator and a source of test signals.



Rackmount version; 145 PAL Gen-Lock Test Signal Generator

MASTER SYNC PULSE GENERATOR WITH COLOR GEN-LOCK

- **625 Line/50 Hz Field**
- **4.433618 MHz Subcarrier**

TEST SIGNAL GENERATOR

- **Full-Field Color Bars**
- **Split-Field Color Bars/Red**
- **Split-Field Color Bars/Y Ref**
- **Staircase**
- **Modulated Pedestal**
- **Convergence Signal**

The 145 PAL GEN-LOCK Test Signal Generator is a high-quality PAL sync pulse and test signal generator for 625 line 50-hertz field standards. The 145 operates as a master or gen-locked sync pulse generator. When gen-locked, special burst-phase recognition circuits assure a complete frame, field, line, subcarrier, and burst phase-lock to a composite video signal applied to the GEN-LOCK loop-through input. Two gen-locking rates are provided, slow, for on-air use, and fast or "crash lock". The "slow" lock can be changed to "fast" lock by a simple internal jumper change. Digital Integrated Circuits are used to achieve stability, accuracy, and reliability. Input provision is made for lockup to external Composite Sync, Subcarrier, and PAL pulse inputs in the EXT mode, or to an external subcarrier only, as selected by internal jumpers.

As a source of test signals, three operating modes provide PAL Color Bars, a 5 step or 10 step staircase with fixed Average Picture Level (APL), and the same staircase with variable APL.

In addition to the color bar and staircase waveforms of the 145, an independent convergence pattern composite video output is provided, suitable for alignment of cameras, monitors, and receivers.

The color bar output is a full-field test signal appearing on every active line and consists of 75% amplitude color bars in descending luminance order with 0% setup. The white reference can be set at 75% or at 100% (for standard 100/0 or 75/0 EBU bars.) Two other versions of color bar signal can be selected: 75% amplitude, 100% white reference with 25% setup (BBC 95% bars), and 100% white reference, 0% setup (100% bars).

The 145 also provides split-field color bars with red, a signal especially useful in VTR setup; or split-field color bars with luminance reference, a signal providing the color bar luminance component for the detection of subcarrier on luminance and the effects of luminance/chrominance time delay.

Any component of the composite video color signal may be turned off. This includes Y, U, V, the entire color bar signal, sync, and burst (either U or V component only or both).

The staircase signal is particularly useful with a TEKTRONIX Vectorscope to measure differential phase and differential gain. Luminance channel linearity may also be measured using the TEKTRONIX video staircase differentiator part #015-0154-00. (The transient response of the staircase signal component is determined by a $\sin^2$ filter whose cutoff frequency limits the energy content in the region of the color subcarrier frequency.)

The PAL subcarrier (140 mV p-p) is accurately phased at 180° (it lies along the —U PAL axis and is at the same phase on alternate lines). Subcarrier may be switched off when desired.

To provide ITS (Insertion Test Signal) on the Comp Video output, the color bar signal or the staircase signal is keyed on during a selected line of the vertical blanking interval, either or both fields (line 11-22 on Field 1 and line 324-335 on Field 2).

Normal PAL color burst is provided on the staircase and color bar signals.

A 1 MHz reference signal which is frequency "locked" to the 4.43361875 MHz PAL subcarrier oscillator is provided at the rear of the instrument. The accuracy of the internal subcarrier oscillator may be conveniently verified by comparing the 1 MHz reference with known frequencies, such as the Droitwich 200 kHz radio transmission in Europe.

PAL COLOR BARS

Luminance and Chrominance Amplitude Accuracies— (25°C reference) Component amplitude comply with the CCIR signal requirements as defined by CCIR, 12th Plenary Assembly, 1970, Vol. 5, p. 281. Absolute amplitudes of luminance signal, setup, and sync are within 1% or 1.5 mV, whichever is greater. Absolute amplitudes of all subcarrier frequency components (chrominance, U, and V) are within 3%. Relative amplitudes of all subcarrier frequency components (chromanance and burst) are within 1% or residual subcarrier plus 1 mV, whichever is greater, of the red chrominance bar.

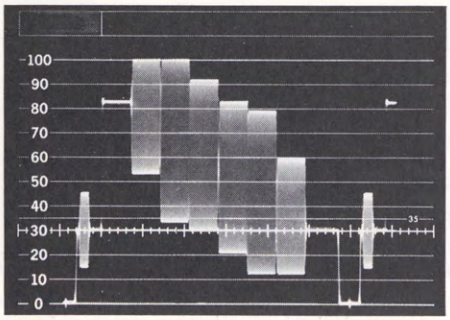
Bar Width— 6.5 μs within 5%.

White Reference— 100% amplitude (normal); or 75% amplitude.

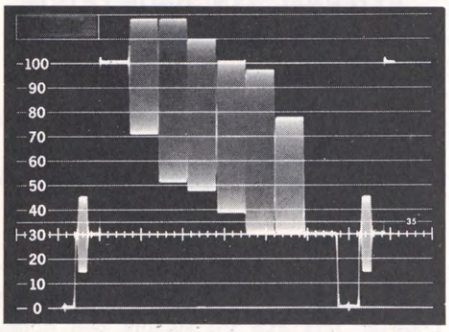
Chrominance—Time difference between luminance and chrominance channels is 20 ns or less. Rise time is 260 ns within 10%. U, V quadrature error is 0.5° or less, X axis phase-switcher error is 0.5° or less.

Residual Subcarrier—At least 52 dB below 1 V except 30 dB at end of H blanking.

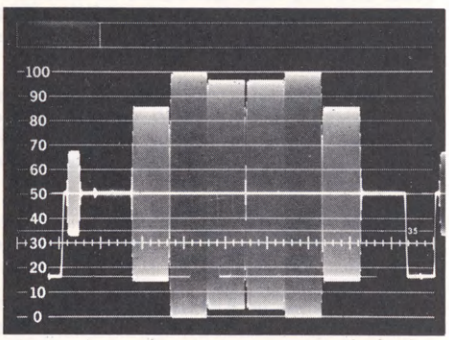
Aberrations—Within 4% of 1 V p-p.



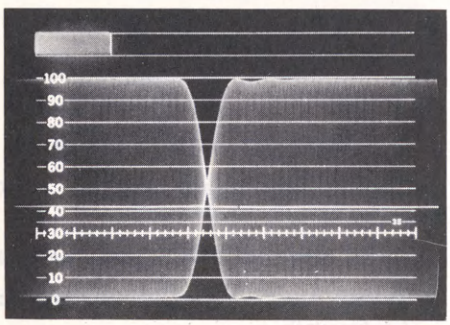
EBU color bars 75% amplitude, 100% saturation, 0% setup, and 75% white reference. EBU color bars—75% amplitude, 100% saturation, 0% setup, and 100% white reference are also available.



BBC 95% color bars—75% amplitude, 100% saturation, 25% setup, and 100% white reference. 100% color bars—100% amplitude, 100% saturation, 0% setup, 100% white reference are also available.



PAL color bars, luminance component switched off (vertical gain of waveform monitor increased).



Chrominance signal, green-magenta transition, 250 ns/cm time base.

Spurious Subcarrier—At least 52 dB below 1 V when viewed on a 529 Waveform Monitor except 30 dB during sync and at end of H blanking. Other spurious outputs are at least 52 dB below 1 V also.

STAIRCASE

Luminance Component—Amplitude is 700 mV within 1%. Single-step amplitude is 140 mV within 1% for 5 step and 70 mV for 10 step. Step rise time is 260 ns within 15%. Step duration at blanking level and white level is 13 μs within 5%. Intermediate step durations are 6.5 μs for 5 step and 3.25 μs for 10 step. Aberrations are within 2% of step amplitude.

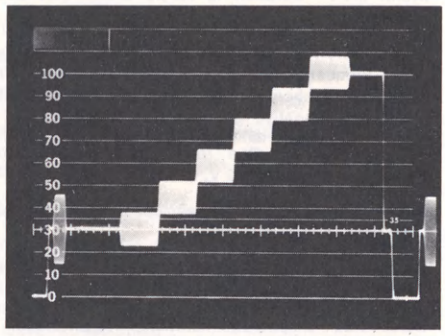
Chrominance Component—Amplitude is 140 mV, or 280 mV, or off (front panel selectable) within 3%. Phase is 180°.

Differential Phase— 0.1° or less.

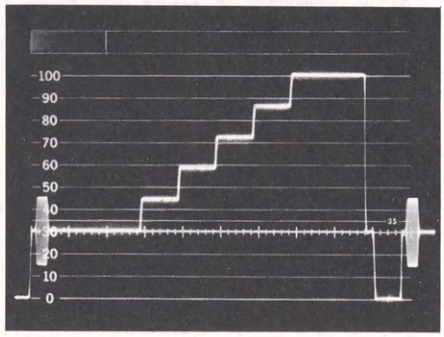
Differential Gain— 0.5% or less at 12.5%, 50% and 87.5% APL.

Subcarrier Envelope—Rise time is 260 ns within 15% and duration is 39 μs within 5%.

50% FIXED APL—Each active line carries the modulated staircase signal. APL is 50%.



5 step staircase waveform with PAL subcarrier along -U axis. PAL burst is provided. Note white reference level following the modulation.



5 step staircase waveform, luminance only. Note double width black and white steps. Luminance transitions are $\sin^2$ shaped of approx 260 ns rise time.

MODULATED PEDESTAL

A unique, TEKTRONIX-developed, chroma-step signal provides a means to check luminance signal distortion caused by rectification of the subcarrier signal (chrominance-luminance intermodulation). When a variable APL mode is selected, V subcarrier, may be added to the pedestal lines to produce 140 mV, 420 mV, and 700 mV chroma-steps followed by a pedestal level set by APL control.

The amplitude modulated subcarrier is used to determine the effects of subcarrier rectification upon luminance signals at all APL's through the entire TV system. The modulated pedestal signal is also useful when checking video tape recorders for "chroma banding".

Subcarrier Component—A three-position switch controls the insertion of V subcarrier on the pedestal lines. Pedestal positions are: subcarrier off, unmodulated subcarrier, and modulated subcarrier.

Subcarrier is precisely ±45° from color burst depending upon the phase of burst. As such, it can be used to check correct phasing of both VTR playbacks (when prerecorded on tape) or color picture monitors. Chroma amplitudes are 140 mV, 420 mV, and 700 mV.

Variable APL—Staircase signal is on every fourth line and the same line every frame. Luminance level range is 700 mV in 10 equal increments, within 2%. The 90°/270° subcarrier modulation on the variable APL lines is 30 mV within 20%.

CONVERGENCE PATTERN

The instrument provides a positionable convergence pattern signal separate and independent from the other test signals. It is useful for measuring picture monitor or camera scanning linearity, aspect ratio, and geometric distortion. Displays available are: cross hatch, vertical lines only, horizontal lines only, and cross hatch plus dots (dots appear centered in the rectangles formed by the cross-hatch pattern).

INSERTION TEST SIGNALS

The staircase signal or the color bar signal may be keyed on during a selected line of the vertical blanking interval, either or both fields (line 11-22 on Field 1 and line 324-335 on Field 2). ITS are available on generator Comp Video output only.

GEN-LOCK

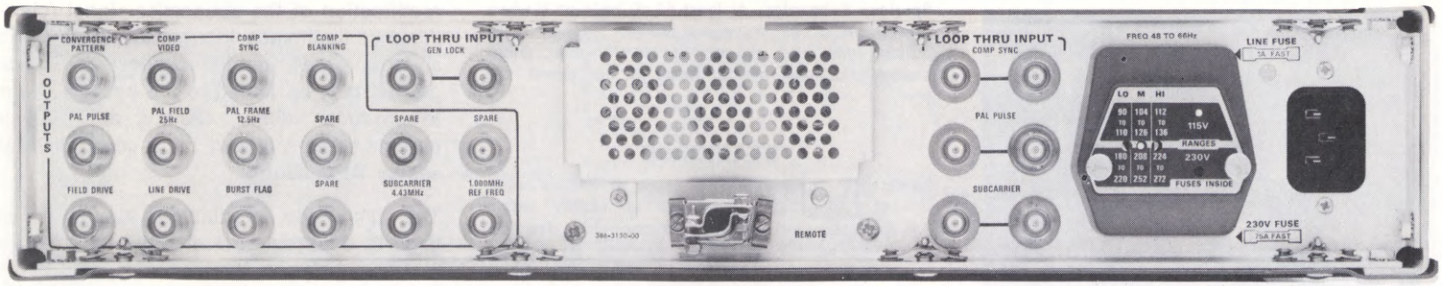
Input Amplitude— 1 V ±6 dB.

Return Loss—At least 46 dB to 5 MHz.

Sync Source—Composite video or "black burst" sync negative.

Burst/Sync—Within 6 dB.

Subcarrier Phase Error—Within 1° with input burst variation of ±10 Hz from 4.43361875 MHz, nominal burst level.



145 Rear Panel

With Temperature Variation (OVEN TEMP NORMAL Lamp On)—Within 5° ambient temperature variation from 0°C to 50°C; within 1°, for any 10°C increment within the range 0°C to 50°C. With input signal variation: Within 1° with input signal variation of ±3 dB from 1.0 V. Within 3° with variation of Burst/Sync Ratio of —6 dB to +10 dB.

Breezeway Stability— 0.2° or less for burst timing errors including burst width variance (8-11 cycles), and breezeway variance ±0.28 μs.

Dynamic Burst Phase Stability— 0.1° or less with APL variation from 10% to 90%.

Phase Error Due to Noise—Within 1° with RMS white noise at —24 dB below 700 mV, p-p picture signal.

CHROMA PHASE Control Range—Greater than 360°.

Loss of Burst Lock—Indicated by front-panel lamp. Internal subcarrier freeruns at 4.43361875 MHz within 5 Hz. Subcarrier is not phase-locked to sync if external sync is present.

Loss of Sync Indicator—Indicated by front-panel lamp. Instrument returns instantly to internal color standard (loss of burst indicator lamp also comes on).

Sync Delay Range—Adjustable so that output sync from the 145 may be delayed at least —3 μs or advanced to +1 μs. Factory set to coincidence.

Sync Stability— Within 70 ns.

Pull-in Time— 200 ms max.

Field/Frame Sync—Direct acting within one field. No time offset is provided.

Subcarrier—Frequency is 4.43361875 MHz (long term drift) within 1 Hz/2 week period. Outputs—three outputs (one front panel and two rear panels). Output level is 2 V p-p within 0.2 V. Output frequency is unaffected by position of 25 Hz offset on front panel.

Composite Sync—A front-panel and a rear-panel output is provided. Output level is 4 V* within 0.2 V. Rise time is 150 ns within 15%.

PAL Pulse—Two outputs (one front, one rear panel). Amplitude and phasing are internally selected to be either of the following: (1) Squarewave —1 V p-p within 0.05 V with transitions occuring with each horizontal sync pulse. Either positive or negative transition is coincident with leading edge of line sync pulse with 135° or 225° burst phasing, (as internally selected). (2) Pulse —4 V* p-p within 0.2 V, duration 4.7 μs within 0.2 μs with negative transition coincident with leading edge of line sync pulse on lines with 135° or 225° burst phasing, (as internally selected).

Composite Blanking—One rear-panel output provides 4 V* within 0.2 V. Rise time is 150 ns.

Line Drive—One output (on rear panel). Output level is 4 V* within 0.2 V. Rise time is 150 ns.

Field Drive—One rear panel; level is 4 V* within 0.2 V. Rise time is 150 ns.

Burst Flag—One rear-panel output provides 4 V* within 0.4 V. Duration is 2.3 μs within 5%, delay from horizontal sync is 5.6 μs within 5%.

1 MHz Reference Frequency—One rear-panel output. Frequency is 1.000056 MHz without 25 Hz offset when subcarrier is 4.43361875 MHz with 25 Hz offset; 1 V, negative going, 0.7 μs duration.

PAL Field 25 Hz—One rear-panel output. Output level is 1 V within 0.2 V.

PAL Frame 12.5 Hz—One rear-panel output. Output level is 1 V within 0.2 V.

Line Period—64 μs (derived from PAL subcarrier frequency).

Burst—Half amplitude duration of envelope is 2.2 μs within 5% (approx 10 cycles). Burst delay is 5.6 μs within 0.1 μs. Burst component is 300 mV p-p within 3%. V component is 212 mV p-p within 3%. U component is 212 mV p-p within 3%. Amplitude ratio of U/V is 1.00 within 1%. Amplitude on successive lines—smaller is between 97% and 100% of the larger. Phasing— 135° within 1° and 225° within 1° on successive lines. Phasing between successive burst is 90° within 1°.

Line Blanking— 12.05 μs within .25 μs.

Front Porch— 1.8 μs within 5%.

Line Sync Pulse—Duration is 4.7 μs within 150 ns; rise time is 150 ns within 15%.

Field Period— 20 ms digitally derived from 4.43361875 MHz.

Field Blanking— 25 lines, 1600 μs (digitally derived from 4.43361875 MHz).

Equalization Pulse Sequence Duration—First sequence, 2.5 H (lines); second sequence, 2.5 H (lines).

Field Sync Pulse—Duration 27.3 μs within 0.2 μs.

Interval Between Field Sync Pulse— 4.7 μs within 0.2 μs.

*Can be changed easily with internal jumper to 2 V or 1 V.

EXTERNAL SYNCHRONIZATION SIGNALS

Composite Sync Input—Input amplitude 1 V to 4 V terminated in 75 Ω (½ V composite video to 8 V composite sync). Return loss is at least 46 dB.

PAL Pulse Input—Input amplitude is at least 2 V p-p. Return loss it at least 46 dB. Pulse duration is at least 4 μs or square wave.

Subcarrier Input—Input amplitude is at least 1 V p-p. Return loss is at least 46 dB.

OTHER CHARACTERISTICS

Composite Video Output—Two outputs are provided through BNC type connectors, one front panel and one rear panel. Composite video consists of composite sync and video test signals as selected by front-panel controls. Amplitude is 1 V p-p into 75 Ω. Return loss is at least 30 dB. Isolation is at least 40 dB.

Power Requirements— 90 to 136 Vac or 180 to 272 Vac, 48 Hz to 66 Hz. 55 W max at 230 Vac, 50 Hz. A rear-panel selector provides accommodation for 6 line voltage ranges. (Shipped set at 230 Vac.)

Dimensions and Weights—Cabinet—Height: 3½ in, 8.9 cm; width: 16¾ in, 42. cm; depth: 18½ in, 47.1 cm; net weight: 17¾ lb; 8.0 kg.

Rack: Height: 3½ in, 8.9 kg; width 19 in, 48.3 cm; depth 18½ in, 47.1 cm; net weight: 18½ lbs, 8.4 kg.

INCLUDED ACCESSORIES

75 Ω through-line termination (011-0103-02); 7½ ft, 3-wire power cord (161-0066-00).

R145 also includes rackmounting hardware.

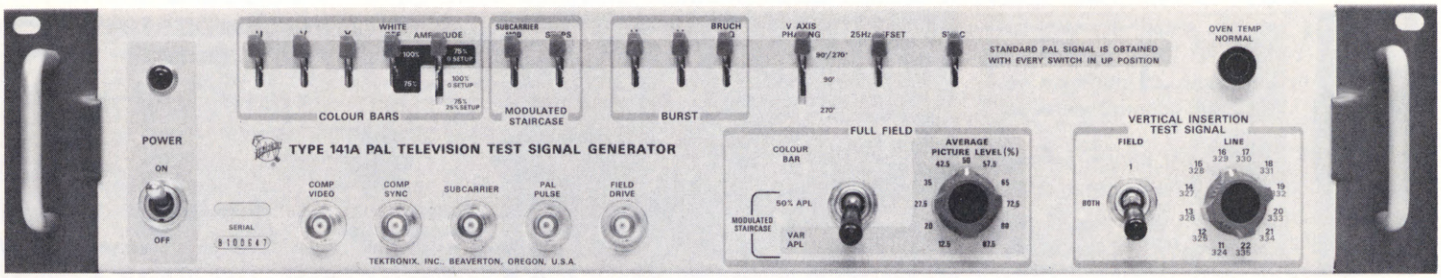
ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

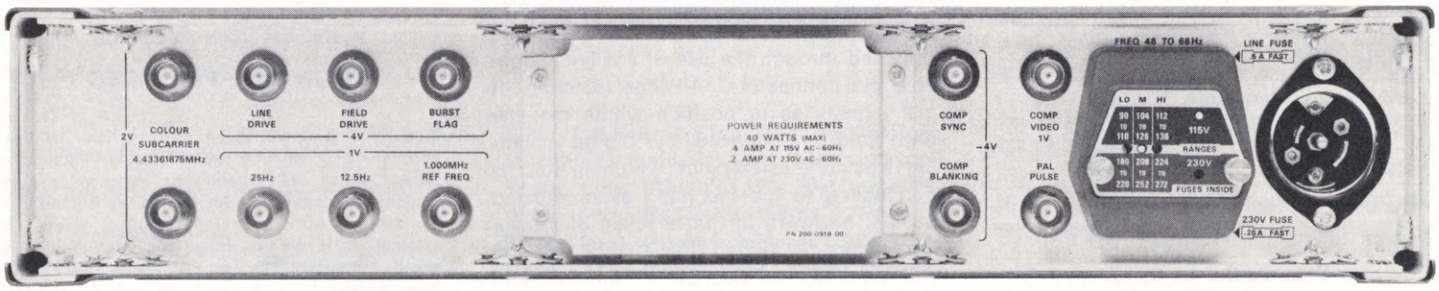
145 PAL Gen-Lock Test Signal Generator

R145 PAL Gen-Lock Test Signal Generator (rackmount)

For applications not requiring gen-lock, this unit is a master sync pulse generator and test signal source.



R141A Rackmount Version; cabinet version has carrying handle less mounting hardware.



141A

The 141A PAL Television Test Signal Generator is a source of high-quality television test signals for 625 line, 50 hertz field standard PAL color TV systems. The 141A differs from the 145 PAL GEN-LOCK Test Signal Generator in several significant ways.

Sync Functions—Self synchronous only.

Color Bars—Full field only.

Staircase— 5 step only.

Modulated Pedestal—Not available.

Chroma Phase—Fixed.

Convergence—Order **Option 1.**

In other respects the 141A performance, generally is the same as that specified for the 145 PAL GEN-LOCK Test Signal Generator. See the preceding pages for dimensions, weights, and included accessories.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

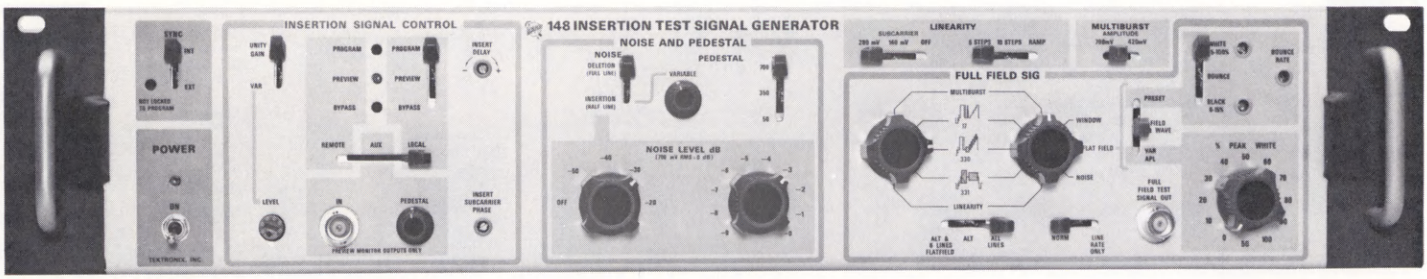
141A PAL Signal Generator

Option 1 (convergence)

R141A PAL Signal Generator (rackmount)

Option 1 (convergence)

This generator supplies all the test signals commonly used for test and measurement of PAL video transmission systems.



Rackmount version; cabinet version has carrying handle less mounting hardware.

Insertion Test Signals
Full-Field Test Signals
Easily Reprogrammable
Safe In-Service VITS Insertion
Noise Measurement
APL Bounce Signal
Source Identification Code
Operates With Sound In Syncs
Locks With Mixed Syncs
Subcarrier
PAL Pulse
Burst Flag

The 148 is a PAL television signal generator supplying all test signals commonly used for test and measurement of video transmission systems. The signals generated are available as full-field composite video test signals and as Insertion Test Signals inserted into the vertical blanking interval of an incoming composite video signal.

Timing information for ITS insertion is derived from the incoming composite video signal. There are extensive provisions within the instrument to modify the parameters of the test signals and their time location on a line or within the vertical blanking interval. This flexibility is provided through the use of easily-changeable pin connectors. All time locations of test signals as to position within the line and field are derived by digital counting from a master clock which in turn is gen-locked to the incoming synchronizing pulses; however, in the absence of incoming composite video (or sync), the 148 will continue to operate in the full-field test signal mode, deriving time information from its own internal oscillator (clock).

VERTICAL INTERVAL INSERTION/DELETION AND PROGRAM CONTROL

The 148 will insert ITS only when gen-locked to an incoming composite video signal. As an ITS deleter/inserter function involves active circuit elements in the program line within the 148, fail-safe means are provided in the event of a malfunction within the instrument, loss of sync, or power. In addition to the automatic fail-safe protection, remote-control manual override capability is also provided.

A preview function allows observation of exactly what lines will be deleted and exactly what signals and levels will be inserted on the program signal before anything is done to the program signal itself. The preview/program function can be remotely controlled.

Changes in the time location of ITS signals are readily made by removing and/or moving color-coded jumpers within the 148. Any signal may be eliminated or moved. Externally generated ITS may be added to the program line if desired.

INSERTION SIGNAL CONTROL FEATURES

Free Running Operation—A warning light indicates absence of incoming synchronizing information without which ITS deletion or insertion is automatically discontinued. An internal synchronization is derived from incoming program video. In external, it is derived from four internal signals: mixed syncs, subcarrier, PAL pulse, and burst flag.

Program Level—A switch selects whether a preset gain, normally adjusted for unity gain between program input and program output, is used or whether a front panel level adjustment is available to normalize incoming signal to provide 1 volt at the program output.

Local-Remote Control of Program and Preview—A switch can shift control of program or preview modes from front panel (local) to a position remote from the 148. When operating under either local or remote control, a light indicates whether a preview, program, or bypass mode is in use.

Program-Preview-Bypass—A switch selects one of three modes: Program-ITS inserted on program line output according to internal selection of test signals and their time address. Preview-ITS inserted only on program as viewed on the preview monitor output; used for verification prior to inserting these signals on program output. Bypass-Incoming program material bypasses 148 functions and is outputted unchanged.

Auxiliary—A noncomposite video signal at the auxiliary input (such as a sweep generator) appears at the preview monitor output connector with composite blanking and sync added. This mode is not available by remote control. A pedestal control provides a dc offset so that the auxiliary signal excursion may be positioned between the black and white limits of the resulting composite video signal.

ITS Subcarrier Phase —A recessed, front-panel control adjusts phase of color subcarrier on internally generated signals to be correct in relation to the phase of incoming burst.

Insertion Delay—A recessed, front-panel control provides a fine adjustment for inserted signals.

INSERTION CONTROL SPECIFICATIONS

Input Level—Adjusted to Unity Gain.

Variable Input Level— ±30%.

Input Return Loss—At least 30 dB to 7 MHz.

Output DC Level—Less than 50 mV (no signal).

Isolation Between Program Preview Outputs—At least 46 dB to 5 MHz.

Isolation Between Program and Program Monitor Outputs—At least 34 dB to 5 MHz.

Inserted Signal Level—Within ±1% of nominal.

Frequency Response, Program, and Preview Channels— ±1%, 50 kHz to 5 MHz; +1%, —5%, 5 MHz to 8 MHz.

2 T Pulse to Bar Ratio—Within 0.25%.

Field Rate Squareware Tilt—Less than 0.5%.

Line Tilt—Less than 0.25%.

Differential Phase at Any APL, Standard Input—Program output less than 0.15°. Preview output less than 0.3°.

Differential Gain at Any APL, Standard Input—Program output less than 0.2%. Preview output less than 0.4%.

Line Time Amplitude Nonlinearity—Less than 0.5%.

Random Noise Output Program Channel—Less than —75 dB RMS.

Residual Subcarrier on Noninserted Lines— 0.7 mV or less.

Hum, Transients on Noninserted Lines—At least 60 dB down.

Spurious Signals During Blanking Time—Inactive line time at least 40 dB down; active ITS lines at 60 dB down.

Signal Attenuation in "Delete" Mode—2 T pulse greater than —70 dB; subcarrier (color bars) greater than —60 dB.

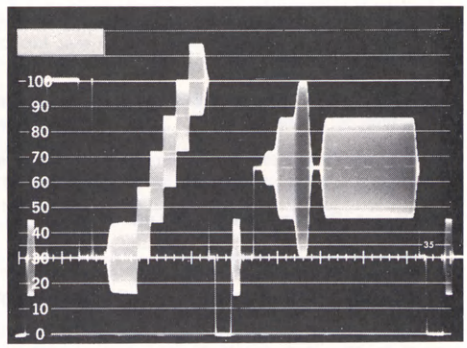
Crosstalk into Program Channel from Internal Signals— 2 T pulse less than —70 dB, subcarrier (color bars) —60 dB.

Unwanted Pedestal at Time of ITS Insertion—Program and Preview Channel: less than 5 mV.

Line Timing Adjustment Range with External Sync—±0.5 μs front panel.

FULL-FIELD OPERATION

A major function of the 148 is to provide full-field test signals separate from program. Full-field signals are generated with or without external synchronizing information. Therefore, there are two modes of full-field operation: free running or synchronized (locked).



Full-field alternation of two signals on all active lines.

Eight full-field signals can be selected: Multiburst, Linearity, Flat Field, Window, Noise, Line 17, Line 330, and Line 331. When operating in a flat-field mode, a white level, preset between 85% and 100%, or a black level, preset between 0% and 15%, may be chosen. An automatic change between white and black is available for testing convenience. This change (bounce), when selected, occurs at an adjustable period from 1.0 seconds to 10.0 seconds.

Eleven APL levels between 0% and 100% of white can be selected for use in the flat field or alternation mode in which flat-field lines are alternated with other selected test signals such as multiburst, linearity, etc.

The eight full-field signals are selected by two switches. This permits any one of the eight signals to be produced on all active lines or any two signals can be alternated on all active lines or any two signals can be paired on two successive lines and alternated with six lines of adjustable flat field.

Full-Field signals are available with or without vertical sync and blanking selectable by front panel.

FLAT-FIELD SIGNAL

The Flat-Field Signal is used primarily for variable average picture level (APL), vertical interval testing. The Flat-Field Signal is a composite video signal which during the active portion of each field has a constant luminance level. During the vertical interval there will be present each test signal which has been programmed for insertion as described in the Vertical Insertion/Deletion section.

The luminance level of the Flat-Field Signal is selectable in eleven increments from 0% to 100% of white. An alternate selection provides a "bounce" between black and white with a variable period from 1 to 10 seconds. Thus the use of the Flat-Field Signal permits the use of test signals in the presence of a selectable APL. This technique is useful in the measurement of APL-dependent distortions.

Luminance Level of the Flat-Field Signal—Within 2% of the indicated level except the 100% level which is within 1%.

Rise Time—Shaped by $\sin^2$ filter with first zero in the frequency domain at 4.43 MHz ≈200 ns.

PULSE AND BAR SIGNAL

2 T and T pulses are generated to high precision by two 9 pole Kastelein Filters. The digital programmer provides the high degree of timing accuracy required in these pulses to eliminate jitter and long term drift. The programmer also exactly determines pulse-to-pulse spacing and bar duration. However, the programmer may be readily reprogrammed to produce different spacings of bar widths in 2 μs increments.

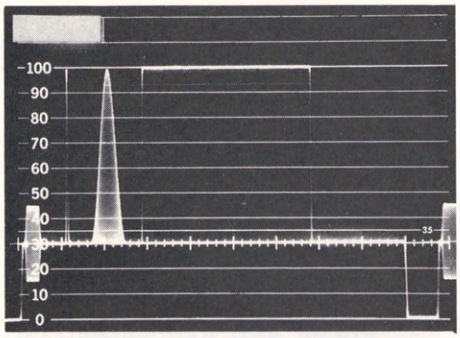
The $\sin^2$ pulse may be either 2 T (200 ns HAD) or T (100 ns HAD). The transitions of the bar are controlled by either of two Kastelein Filters so that frequency spectrum is limited to 4.3 MHz or 8.6 MHz. Shape of these transitions is integrated $\sin^2$.

For a specific application, the user may elect to program the 148 for any combination of T or 2 T pulse and T or 2 T bar. As shipped, the pulse is 2 T, the bar is formed by the 2 T filter. This provides for K factor measurements of short time distortion. Thus the pulse and bar test signal is useful to measure line time and short time distortions.

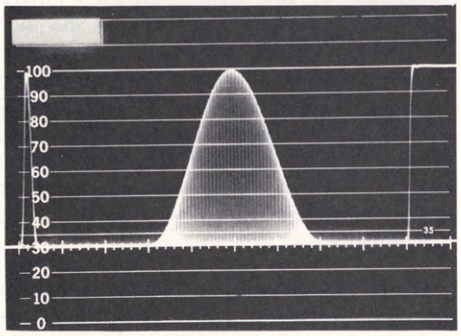
The envelope of the modulated $\sin^2$ pulse is formed by a 9 pole Kastelein filter. This filter is on a separate plug-in circuit board

so that other pulse durations may be obtained with the use of other filters.

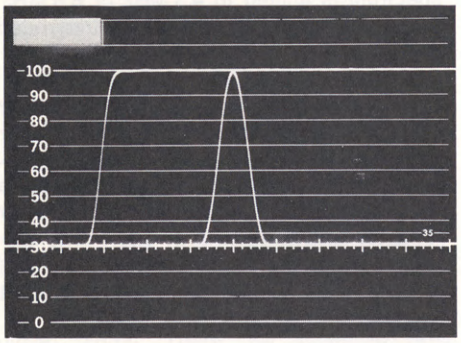
Modulated $\sin^2$ pulse (20 T) is used in measuring relative gain and delay errors between chrominance and luminance signals. The 20 T modulated $\sin^2$ pulse has a 2.0 μs HAD. Greater sensitivity to chrominance-luminance delay errors may be had by using reduced pulse width.



Window signal with 2 T and modulated 20 T $\sin^2$ pulses.



Modulated 20 T pulse magnified.



2 T $\sin^2$ pulse superimposed on bar by double exposure.

2 T Pulse Amplitude—Within 1% of luminance bar.

2 T HAD— 200 ns.

2 T Ringing—Amplitude less than 0.5%; duration less than 2 cycles.

Time Location—Internally programmable in 2 μs increments.

Luminance Bar Amplitude— 700 mV ±1%.

T Bar Rise Time— 100 ns ±15%.

T Bar Time Location—Start and Stop internally programmable n 2 μs increments.

20 T Modulated Pulse Peak Chrominance to Peak Luminance Amplitude Difference—Less than 3 mV.

20 T Modulated Pulse HAD— 2.0 μs.

20 T Modulated Pulse Residual Subcarrier—Less than 3 mV on insertion line.

20 T Modulated Pulse Relative Chroma-Luminance Time Delay—Less than 5 ns.

WINDOW SIGNAL

The Window Signal is the same as the Pulse and Bar except that the "Window" occupies the center 205 lines of each field. A window signal can be used to measure both line time and field time distortions. It is especially useful when observing picture monitors. Where field rate distortion is present, the window signal will be affected to a much greater extent than the pulse and bar signal.

Amplitude— 700 mV.

Rise Time—Internally programmable: either 2 T pulse and T window or T pulse and 2 T window.

FIELD SQUAREWAVE

A sensitive measurement of field time distortion can be made with this signal. In this mode, the 148 provides a composite video signal with 205 active lines at 700 mV, which approximates a 50 Hz squarewave. A composite video signal such as this reveals low-frequency phase and gain distortions much as a simple 50 Hz squarewave will do, but unlike the latter, it can pass through clamper amplifiers.

Amplitude—Within ±1 mV of white reference.

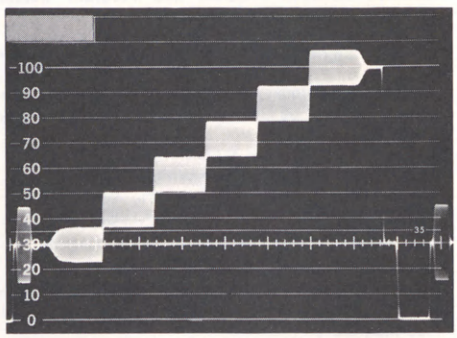
Number of White Lines—65 through 270 and 377 through 582, all remaining active lines are black.

Rise Time—Shaped by $\sin^2$ filter with first zero in frequency domain at 4.3 MHz.

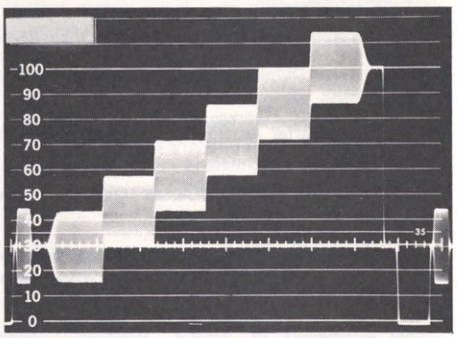
LINEARITY SIGNAL

Linearity—Three linearity test signals are front panel selectable: 5 step, 10 step, and ramp either modulated or unmodulated. The subcarrier component is phase-locked to color burst. Applications include measurements of differential gain and phase, dynamic gain, luminance signal linearity, luminance signal distortion caused by chrominance signal nonlinearity, and burst phase errors.

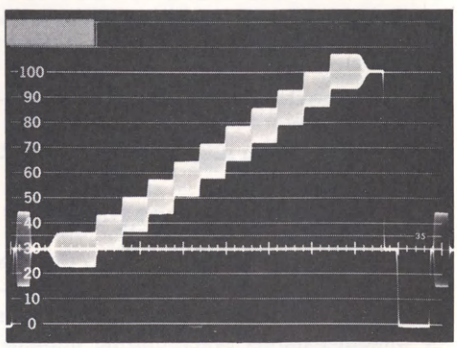
Luminance Component—Peak amplitude 700 mV within 1%, 5 step, 10 step, or ramp.



Linearity signal, 5 step, 140 mV subcarrier.



Linearity signal, 5 step, 280 mV subcarrier.



Linearity signal, 10 step, 140 mV subcarrier.

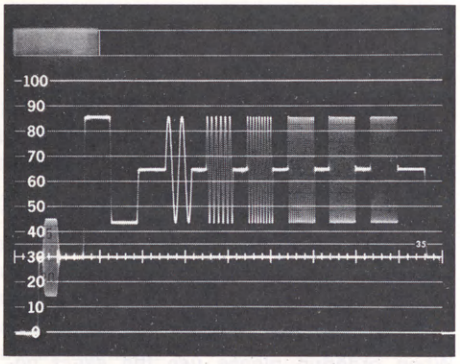
Riser Shape—Determined by filter with first zero at 4.43 MHz.

Chrominance Component—Amplitude is selectable: 0 mV, 140 mV, 280 mV.

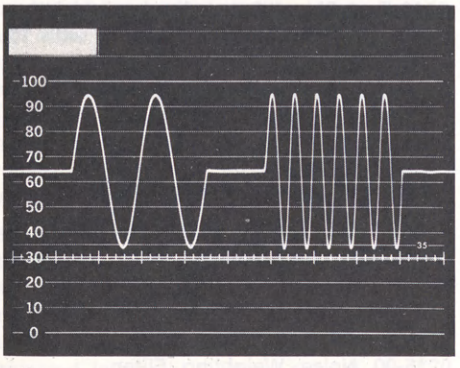
MULTIBURST SIGNAL

Multiburst is generated by a function generator controlled by a digital programmer. The function generator approach eliminates the need for individual start-stop oscillators for each burst and individual amplitude and ac axis adjustments for each burst. Thus each burst start time is completely stable and each burst consists of an exact integer number of cycles, regardless of the frequency. Each burst starts at 0° of the first cycle and ends at 360° of the last cycle. Location of the white flag may be programmed with relation to the bursts as a means of source identification.

White Reference Amplitude— 700 mV ±1% and 420 mV ±1%.



420 mV Multiburst—Noise burst starts and stops precisely at the same level.



Multiburst magnified to show start and stop transitions.

Burst Amplitude—Two amplitudes, Normal or Reduced, are front panel selectable. Internal adjustment presets normal amplitude value.

Burst Frequencies— 0.5, 1, 2, 4.0, 4.8, and 5.8 MHz within 3%. Each burst frequency independently adjustable (internally).

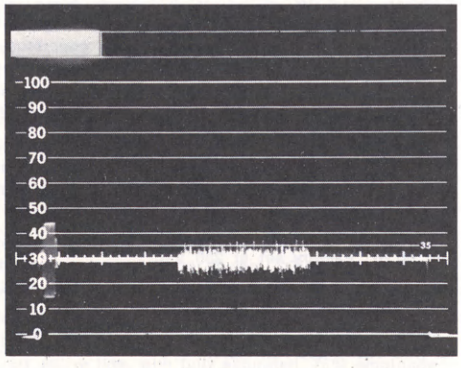
Timing—Each burst starts at 0° of the first cycle and ends at 360° of the last cycle.

NOISE

The 148 offers a unique signal-to-noise measuring technique for "in-service" testing during the vertical interval. The noise present in the middle portion of an internally selected line is deleted and noise generated in a calibrated source is inserted for measurement by comparison. The user varies a calibrated attenuator until inserted noise and incoming noise appear the same on a waveform monitor. The noise values measured are independent of operator interpretation errors to within 2 dB.

Where transmission noise is to be measured, the noise may be deleted on an entire line at the point from which the noise is to be measured using one 148. Further down the transmission system, a second 148 will match the noise level in the manner described previously. This process may be repeated and the transmission noise level determined for several sections of the transmission system, or its overall performance evaluated.

Noise may be measured at 50 mV, 350 mV, or 700 mV luminance levels. The calibrated noise generator provides "flat" (white) noise. External noise filters are required with the 148 when making noise measurements.



Half line adjustable noise comparison signal inserted on a full line.

Noise Pedestal Amplitude— 50 mV ±5 mV, 350 mV within 2%, or 700 mV within 2%.

Variable Pedestal— ±5% variation provided for half line insertion in order to exactly match pedestal level of incoming signal.

Noise Levels— —20 dB to —59 dB in 1 dB steps (0 dB = 700 mV RMS).

Flat Noise Spectrum—Energy unit bandwidth: 15 kHz to 5 MHz ±6 dB. (Spectrum extends well beyond 5 MHz.)

Output Impedance— 75 Ω.

Return Loss—At least 30 dB.

INSERTION TEST SIGNALS

LINE 17, LINE 330, AND LINE 331

The signals used as vertical interval test signals on line 17, 330, and 331 are also available full field. The elements of these signals are specified as follows:

LUMINANCE BAR

Amplitude— 0.7 V ±1%.

Shape and Time of Rise and Fall—Approx 100 ns (or may be derived from the shaping network of the sine-squared pulse or of the staircase waveform).

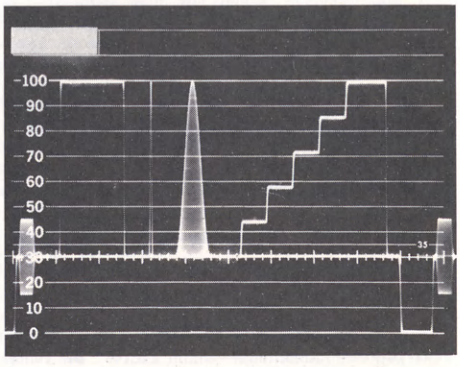
Tilt—Less than 0.5% for 10 μs.

STAIRCASE SIGNAL

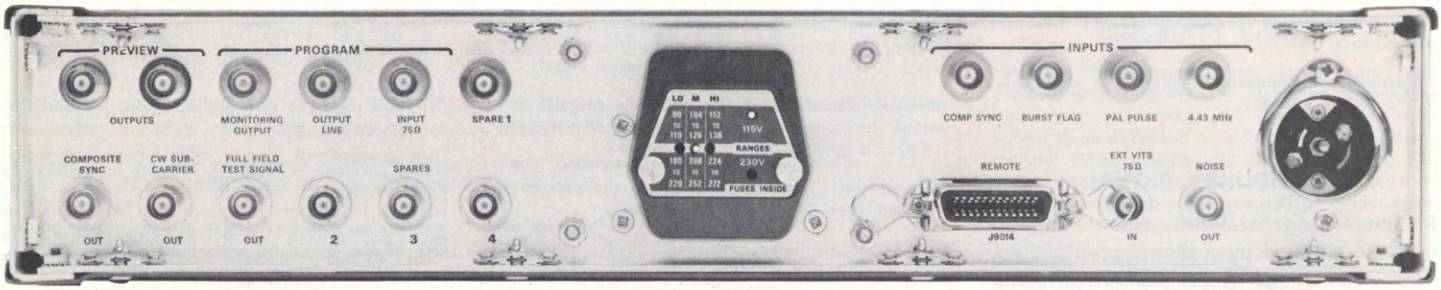
Level of the Uppermost Tread of Staircase—Within ±1% of luminance-bar amplitude.

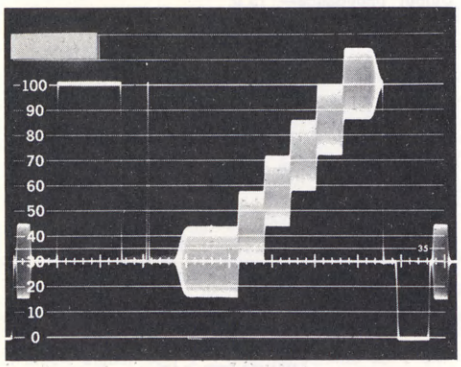
Number of Risers— 5.

Shape of Risers—Determined by a filter with a first zero at 4.43 MHz.

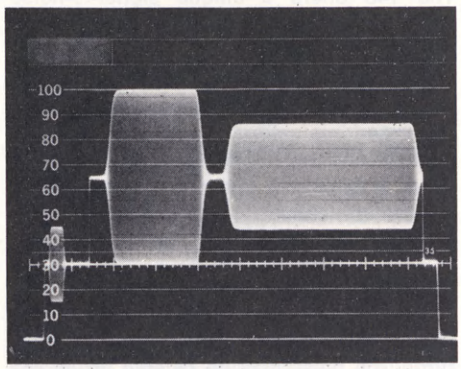


Line 17

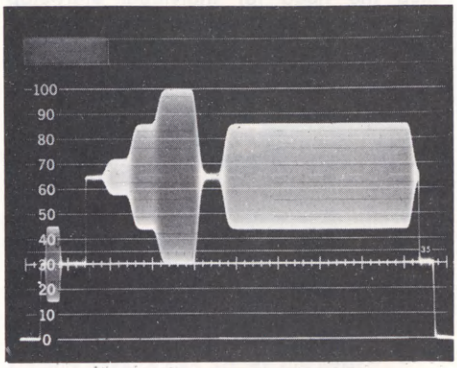




Line 330



Line 331 with single level chrominance bar.



Line 331

Line-Time Nonlinearity—The difference in amplitude between the largest and smallest risers is less than 0.5% of the largest amplitude.

Superimposed Subcarrier Frequency and Phase—4.43361875 MHz ±10 Hz; 60° ±5° to the B-Y axis, referred to the burst (when present).

Rise and Fall Times of Subcarrier Superimposed on Staircase—1 μs approx.

Inherent Differential Gain—Less than 0.5%.

Inherent Differential Phase—Less than 0.2°

Amplitude of Superimposed Subcarrier—0.28 V p-p ±2% of luminance-bar amplitude.

2 T PULSE

Amplitude—±1% of luminance-bar amplitude.
Half-Amplitude Duration—200 ±6 ns.

20 T COMPOSITE PULSE

Amplitude—Within ±1% of luminance-bar amplitude.

Half-Amplitude Duration—2 ±0.06 μs.

Inherent Chrominance/Luminance Gain Inequality—Less than 0.5%.

Inherent Chrominance/Luminance Delay Inequality—Less than 10 ns.

Subcarrier Leak—Less than 3.5 mV p-p on insertion lines.

Harmonic Content of Subcarrier—Less than —40 dB.

Chroma Phase—60° (internally adjustable to any phase).

CHROMINANCE BAR

Peak-To-Peak Amplitude—Within ±1% of luminance-bar amplitude.

Pedestal—0.35 V ±1%.

Inherent Chrominance/Luminance Cross Modulation—0.5% of pedestal amplitude.

Envelope Rise Time—1 μs approx.

THREE-LEVEL CHROMINANCE BAR

Position of Transitions—7H/32, 9H/32, 11H/32, and 14H/32.

Peak-to-Peak Amplitudes—1st section, within ±1% of 1/5 of the luminance bar (nominal value: 0.14 V). 2nd section, within ±1% of 3/5 of the luminance bar (nominal value: 0.42 V). 3rd section, within ±1% of the luminance bar (nominal value: 0.7 V).

Pedestal—0.35 V ±1%.

Chrominance/Luminance Cross Modulation—Less than 0.5% of pedestal amplitude.

Envelope Rise Time—1 μs approx.

CHROMINANCE REFERENCE

Peak-To-Peak Amplitude—0.42 V ±1% of luminance-bar amplitude.

Pedestal—350 mV within 1%.

Envelope Rise Time—1 μs approx.

SOURCE IDENTIFICATION CODE

The 148 is a source identification code generator with up to 25 pulses in any combination on line 16 or 329.

Pulse Width—1 μs.
One Level—630 to 700 mV above blanking.
Zero Level—Within 25 mV of blanking.

OTHER CHARACTERISTICS

Power Requirements—90 to 136 VAC or 180 to 272 VAC, 48 Hz to 66 H, 55 watts max at 115 VAC and 60 Hz. Factory set at 230 Vac.

Inputs—External ITS Input, Program Input, Auxiliary Input, Composite Sync, and Subcarrier.
Outputs—Program, Program Monitor, Preview Monitor (two each), and Full Field.

Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0° to +50°C.

INCLUDED ACCESSORIES

7½ ft power cable, three wire (161-0036-00); 75 Ω, BNC termination (011-0103-02); 2 each BNC-T adapters (103-0030-00). R148 includes rackmounting hardware (351-0195-00).

Dimensions and Weights

	148		R148	
	in	cm	in	cm
Height	3⅞	9.9	3½	8.9
Width	17⅞	45.5	19	48.0
Depth	17⅛	43.6	19⅝	49.9
	lb	kg	lb	kg
Net Weight	≈19	≈8.6	≈20	≈9.1
Shipping Weight	≈35	≈15.9	≈36	≈16.3

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

148 Test Signal Generator
R148 Test Signal Generator (rackmount)
Option 1 Australian Test Signals with 10 T Filter.
Option 2 Australian Test Signals with 20 T Filter.

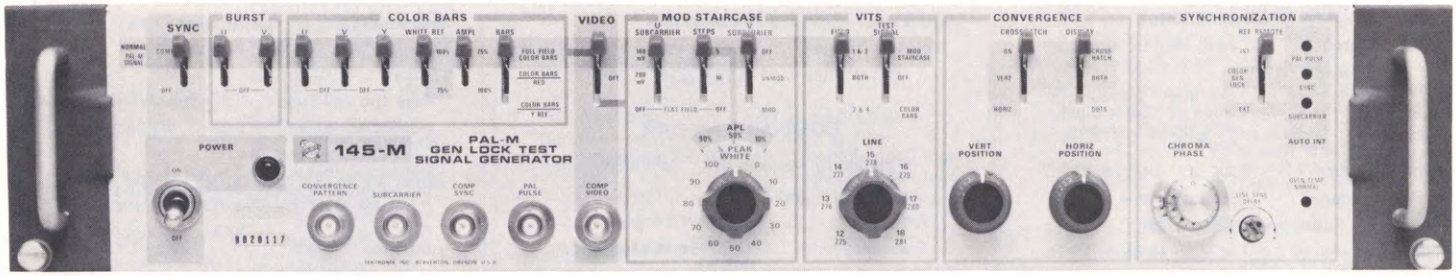
NOISE MEASUREMENT FILTERS

External filters are required with the 148 Generator when making noise measurements.

For systems using 625/50 standards order 015-0213-00 Low Pass Filter and 015-0215-00 Noise Weighting Filter.

015-0213-00 Low-Pass 5.0 MHz 625/50
015-0215-00 Noise-Weighting 5.0 MHz 625/50
015-0220-00 Low-Pass 6.0 MHz 625/50

This unit is a color gen-lock, master sync pulse generator, and a source of test signals.



Rackmount version; cabinet version has carrying handle less mounting hardware.

MASTER SYNC PULSE GENERATOR WITH COLOR GEN-LOCK

TEST SIGNAL GENERATOR
- **Full-Field Color Bars**
- **Split-Field Color Bars/Red**
- **Split-Field Color Bars/Y Ref**
- **Staircase**
- **Modulated Pedestal**
- **Convergence Signal**

The 145-M PAL-M Gen Lock Test Signal Generator is a source of high-quality television test signals for 525 line, 60 Hz field, PAL-M (3.57561149 MHz Subcarrier) color TV systems. The 145-M can be color gen-locked to a composite video signal source, or referenced to external sub-carrier, sync and PAL Pulse, or operated as a master sync pulse generator with its own internal frequency standard.

Recognition circuits for field sync, line sync, burst phase, and alternate-line phase allow the 145-M to gen-lock to the burst phase, subcarrier, line, field, and frame of a composite video signal applied to the loop-through GEN LOCK inputs. In the COLOR GEN LOCK Reference synchronization mode, the 145-M has fast gen-lock or slow (controlled-rate) gen-lock for broadcast applications.

Should synchronization be lost while operating in the externally-referenced modes, front-panel lights will indicate loss of lock and automatic switching by the 145-M to internal references. The lights can be programmed internally to show normal conditions as all lights "off" or all lights "on". The 145-M's reference mode switch can be remoted, along with the indicator light functions via the rear panel.

The 145-M provides PAL-M color bars (full field or split field), 5- or 10-step staircases (modulated or unmodulated), modulated pedestals, flat field, fixed and variable APL's — all available as Full Field or Vertical Interval Test Signals (on the Comp Video output only) or both. A convergence pattern signal for converging receivers and monitors is also available, independent of and separate from the other test signals.

Color Standards
Internal subcarrier, external subcarrier, or COLOR GEN-LOCK can be selected for color standard references. The 145-M's internal color standard has a proportional-control oven for the quartz crystal and the entire oscillator circuit.

The phase of burst contained in the video output is variable over a 360° range with respect to the phase of the color subcarrier output. When an external color standard is used, the phase of the burst may be varied 360° with respect to the external subcarrier source.

Sync Generator
Subcarrier, PAL Pulse, Composite Sync, and Composite Video signals are available at the front and rear panels for synchronizing other PAL-M system equipment. Subcarrier frequency stability and other specifications conform to current CCIR recommendations.

The front panel signals are also available at the rear panel along with Composite Blanking, 30 Hz PAL Field, 15 Hz PAL Frame, Vert Drive, Horiz Drive, and Burst Flag. Comp Sync, Comp Blanking, PAL Pulse, Vert Drive, Horiz Drive, and Burst Flag can all be set individually for 1, 2, or 4 V output levels (into 75 Ω loads).

Composite Video
Full composite video signals, with or without Vertical Interval Test Signals (VITS), are available at the front or rear panels via isolated 75 Ω outputs.

Composite Video outputs conform in all time and amplitude parameters to current CCIR standards for 525 line, 60 Hz PAL-M color signals.

Color Bar Signals
The normal color bar output signal is full field, on every active line, with fully saturated, 75% amplitude bars in descending luminance order. Two other color bar signals provide 100% amplitude and 75% white reference. All color bars have a 5% setup level.

Flexibility is added to the color bars mode with two special split field displays: Color Bars/Red and Color Bars/Y Ref. In the Color Bars/Red split field display, the lower half of the display is filled with the same red as the red color bar. This split field display is especially useful in VTR setups. In the Color Bars/Y Ref split field display, the upper half of the display shows 100% saturation of the standard color bars, while the lower half shows 0% saturation. The resulting display is useful for checking gray-scale tracking and chrominance-luminance timing.

Staircase Signals
A normal PAL-M 5 step modulated staircase signal is available on every active line at a fixed APL of 50% or on every fifth line with a variable APL, ranging from 10% APL to 90% APL in ten equal increments. A 10 step staircase and a Flat Field display are also available.

The staircase steps are normally modulated with 140 mV of the U component (accurately phased at 0°) of the PAL-M subcarrier. The subcarrier vector lines along the +U axis on all lines carrying the staircase signal. It may be switched off if desired. The last step of the staircase (at white level) is doubled width so that it can be viewed with and without subcarrier to detect clipping in the white direction.

During variable APL modes, an amplitude-modulated or unmodulated V component subcarrier may be added to the pedestal signal. This modulated pedestal is useful to check chrominance-to-luminance signal distortions.

The staircase signal is particularly useful for measuring differential gain and phase, dynamic gain, luminance signal linearity, and luminance distortion caused by chrominance signal non-linearity in systems under test.

Vertical Interval Test Signals
To provide Vertical Interval Test Signal (VITS) information on the Comp Video output, either a Modulated Staircase or Color Bars can be keyed on during selected lines of the field blanking interval in either or both pairs of fields.

Convergence Pattern
Composite video convergence pattern signals, separate and independent from the other test signals, are available at the front and rear panels via 75 Ω isolated outputs. Front panel controls select crosshatch lines (vertical, horizontal, or both), dots, or both lines and dots, all with positioning in both axes.

The Convergence Pattern signal contains no burst or chrominance information. It is useful for measuring picture monitor or camera scanning linearity, aspect ratio, and geometric distortion.

GEN LOCK REFERENCE

Input Configuration	75 Ω, loop-through
Input Requirements	
Sync Source	Nominal 1 V composite video or "Color Black with Syncs", sync-negative
Sync Amplitude	300 mV, within 6 dB
Burst Amplitude	300 mV, within 12 dB
Burst/Sync Ratio	Within 6 dB
Return Loss	At least 46 dB to 5 MHz
Lock-Up Sequence	Burst (Subcarrier)—PAL Phase—Line—Field—Sync
Acquisition Time	
All Sequence Steps Set to:	
Slow	3 s, max
Fast	250 ms, max
Loss of Lock	Indicated by front-panel lights. Automatic switching to partial or full Internal
Gen-locked Subcarrier	
Phase Error	
With Frequency Change	Within 0.5°, with input burst change of ±10 Hz
With Temperature Change (OVEN TEMP NORMAL Light On)	Within 5°, with ambient temperature change over range of 0°C to 50°C Within 1° for any 10°C increment within that range
With Burst Amplitude Change	Within 1° with amplitude change of 210 mV to 420 mV. Within 3° with amplitude change of 75 mV to 1.2 V
Phase Stability	
Breezeway Effect	0.2° or less for burst including burst width variance (8-10 cycles) and breezeway variance (±0.28 μs)
Dynamic APL	0.1° or less with APL Change from 10% to 90%
Noise Effect	Within 1° with RMS white noise at 24 dB below 700 mV (p-p) picture signal
CHROMA PHASE Range	360° range via front-panel goniometer
LINE SYNC DELAY	
Range	Adjustable to advance 145-M sync at least 3 μs or delay at least 1 μs
Stability	Within 70 ns over ambient temperature of 0°C to +50°C
Jitter	4 ns or less
Field/Frame Sync	Direct-acting within 1 field. No time offset provided

EXTERNAL REFERENCE

Input Configurations	75 Ω, loop-through
Input Requirements	
SUBCARRIER Input	
Amplitude	1.0 to 4.0 V p-p
Frequency	3.57561149 MHz, within 10 Hz
Return Loss	At least 46 dB to 3.57561149 MHz
COMP SYNC Input	
Amplitude	2.0 to 8.0 V p-p
Polarity	Negative-going
Return Loss	At least 46 dB to 5 MHz
PAL PULSE Input	
Amplitude	2.0 to 8.0 V p-p negative-going
Waveshape	Pulse or square wave
Duration	
Pulse	At least 4 μs
Square Wave	One line between each transition
Phasing	Internally selectable
Pulse	Negative-going transitions with start of line sync on either a +V or −V line. Factory set to +V
Square Wave	Positive-going transitions coincident with start of line sync on either a +V or −V line, Factory set to +V
Return Loss	At least 46 dB to 5 MHz
Lock-Up Time	Same as Gen Lock if all external signals are from the same source
Loss of Lock	Indicated by front-panel lights. Automatic switching to partial or full Internal
Subcarrier Stability	Output follows input
LINE SYNC DELAY	Same as Gen Lock
CHROMA PHASE Range	Same as Gen Lock

INTERNAL REFERENCE (SYNC PULSE GENERATOR)

SUBCARRIER Outputs	
Frequency	3.57561149 MHz ±10 Hz
Amplitude into 75 Ω	2 V p-p, within 10%
Return Loss	At least 30 dB
Isolation	At least 30 dB
COMP SYNC Outputs	
Output Level into 75 Ω	1 V, 2 V, or 4 V (Factory-set), within 5%. (Internally selectable)
Return Loss	At least 30 dB
Isolation	At least 40 dB
Timing	
Rise and Fall Time	115 ns, within 10%
Equalizing Pulse Duration	2.33 μs, within 0.5 μs
Equalizing Pulse Sequence Duration (First and Second)	3 H (Lines) Digitally determined from 3.57561149 MHz
Field Sync Duration	27.3 μs, within 0.2 μs
Horizontal Sync Duration	4.71 μs, within 0.05 μs
Field Sync Pulse Sequence Duration	3 H (Lines) Digitally determined from 3.57561149 MHz
Interval Between Field Sync Pulses	4.5 μs, within 0.2 μs
Jitter	4 ns or less
COMP BLANKING Output	
Output Level into 75 Ω	1 V, 2 V, or 4 V (Factory-set) within 5%. (Internally selectable)
Return Loss	At least 30 dB
Line Blanking Duration	11.1 μs, within 0.25 μs
Rise and Fall Time	115 ns within 10%
Field Blanking Duration	21 H (1334 μs)
Rise and Fall Time	115 ns within 10%
BURST FLAG Output	
Output Level into 75 Ω	1 V, 2 V, or 4 V (Factory-set), within 5% (Internally selectable)
Return Loss	At least 30 dB
Delay From Line	5.8 μs, within 0.1 μs
Rise and Fall Time	250 ns, within 50 ns
Duration	2.5 μs, within 5%
HORIZ DRIVE Output	
Output Level into 75 Ω	1 V, 2 V, or 4 V (Factory-set), within 5% (Internally selectable)
Return Loss	At least 30 dB
Rise and Fall Time	115 ns, within 10%
Timing	Leading edge coincident with leading edge of line sync or start of line blanking (Internally selectable)
Duration	6.35 μs, within 5% (Line Sync) (Factory-set) 7.9 μs, within 5% (Line Blanking)
VERT DRIVE Output	
Output Level into 75 Ω	1 V, 2 V, or 4 V (Factory-set), within 5% (Internally selectable)
Return Loss	At least 30 dB
Rise and Fall Time	115 ns, within 10%

Timing	Leading edge coincident with the start of the first equalizing pulse (Factory set) (Internally selectable)
Duration	667.38 μs
PAL PULSE Outputs	
Waveshapes	Pulse (Factory-set) or square wave (Internally selectable)
Output Level into 75 Ω	1 V, 2 V, or 4 V (Factory-set), within 5%. (Internally selectable)
Return Loss	At least 30 dB
Isolation	At least 40 dB
Rise and Fall Time	115 ns, within 10%
Square wave Phasing	Negative and positive transitions occur alternately with each line sync pulse, coincident with the leading edge of line sync on either +V or −V lines. Factory-set to +V
Duration	One line between each transition
Pulse	
Phasing	Negative transition coincident with leading edge of line sync on either +V or −V lines. Factory set to +V
Duration	4.7 μs, within 0.2 μs
PAL FIELD 30 Hz Output	
Output Level into 75 Ω	1 V, within 0.2 V
Phasing	Positive during fields 1 and 3
Transition Timing	3 lines prior to Field Blanking
PAL FRAME 15 Hz Output	
Output Level into 75 Ω	1 V, within 0.2 V
Phasing	Positive during fields 1 and 2. +V or −V phasing internally selectable. Factory set to +V
Transition Timing	3 lines prior to Field Blanking

COMP VIDEO OUTPUT

Amplitude (into 75 Ω)	1 V, p-p, made up of Chrominance, Luminance, and Sync
Sync Component	−300 mV, within 1%, from Blanking Level
Peak Level	+700 mV, within 1%, from Blanking Level
Blanking dc Level	0 mV, within 100 mV
Return Loss	At least 30 dB
Isolation	At least 40 dB
Field Period	16.67 ms Digitally determined from 3.57561149 MHz
Line Period	63.5 μs. Digitally determined from 3.57561149 MHz
Burst	
Delay from Line Sync	5.8 μs within 0.1 μs
Half Amplitude Duration of Envelope	2.52 μs, within 0.28 μs (approx 9 cycles)
Burst Amplitude	300 mV, within 3%
V Component	212 mV, within 3%
U Component	212 mV, within 3%
Amplitude Ratio (U/V)	1.00, within 1%
Amplitude on Successive Lines	Smaller is 97% to 100% of the larger
Phasing	135°, within 1°, or 225° within 1°, on successive lines. Phasing between successive bursts is 90°, within 1°

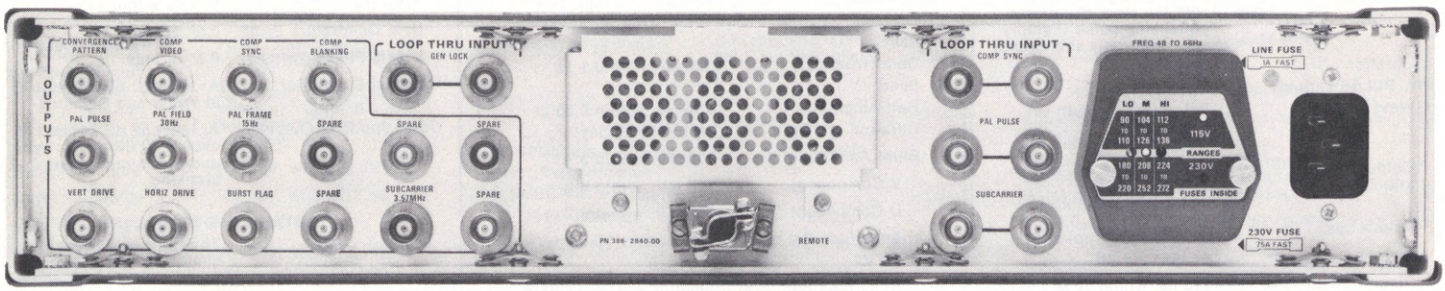
COLOR BARS

Luminance and Chrominance Component Accuracy	Absolute amplitudes of luminance signal and sync are within 1% or 1.5 mV, whichever is greater
	Absolute amplitudes of all subcarrier frequency components (chrominance, U, V, are within 3%. Relative amplitudes of all subcarrier frequency components are within 1%, or residual subcarrier plus 1 mV, whichever is greater, of the red chrominance bar
Full Field Bars Sequence	W (White), Y1 (Yellow), Cy (Cyan), Mg (Magenta), R (Red), Blu (Blue), Blk (Black)
Bar Width	6.6 μs within 5%
Risetime (White Bar)	115 ns within 10%
Split Field Displays	
COLOR BARS/RED	Upper half of display filled with normal color bars sequence while lower half of display is filled with the same chrominance and luminance as the Red bar
COLOR BARS/Y REF	Upper half of display filled with normal color bars sequence while lower half displays same sequence of luminance only
Timing	Internally selectable
½ Field Split	Starts at line 140 (404). Factory-set
¾ Field Split	Starts at line 200 (464)
Risetime	375 ns within 10%
U, V Quadrature Error	0.5° or less
V Axis Phase Switcher	0.5° or less
Residual Subcarrier	At least 52 dB below 1 V at White and Blanking
Other Spurious Outputs	At least 52 dB below 1 V except 30 dB during sync and at the end of line blanking

STAIRCASE SIGNAL

The Staircase Signal is similar to that in volume 5 of CCIR, recommendations 421-2 and 451-1, but differs in the following respect: White reference and black reference signals are provided and the subcarrier is phased to the +U axis

Luminance Component	
Step Amplitude	
5 Steps	140 mV within 1%
10 Steps	70 mV within 3%
Peak Amplitude	700 mV within 1%
Step Rise Time	260 ns within 15%
Aberrations	Within 2%
Step Rise Time	
Blanking Level	13.2 μs within 5%
White Level	
5 Steps	13.2 μs within 5%
10 Steps	9.9 μs, within 5%
Intermediate	
5 Steps	6.6 μs within 5%
10 Steps	3.3 μs within 5%
U Subcarrier Chrominance Component	
Amplitude	
140 mV	140 mV p-p within 3%
280 mV	280 mV p-p within 3%
Phase	0°
Differential Phase	
10%, 50%, 90% APL	0.1° or less
Differential Gain	
10%, 50%, 90% APL	0.5% or less
Subcarrier Envelope	
Rise Time	400 ns within 15%
Duration	40 μs within 5%
APL Pedestal	Staircase signal on every fifth line and the same line each frame
Luminance Level Range	0 V to 700 mV within 2% in 10 equal increments



V Subcarrier	Alternating on 90° and 270° axes
Chrominance Component	
Unmodulated	30 mV within 5 mV
Modulated	140 mV within 5 mV (13.2 μs)
	280 mV within 5 mV (13.2 μs)
	420 mV within 5 mV (13.2 μs)
	Incidental phase error between 280 mV and 420 mV levels, 0.5° or less

CONVERGENCE PATTERN

Convergence Pattern	
Setup	50 mV, within 5%
Sync Amplitude	300 mV within 5%
Pulse Amplitude	487.5 mV within 5%
Amplitude (Sync Tip to Pulse Peak)	837.5 mV
Return Loss	At least 30 dB
Blanking dc Level	0 mV within 100 mV
Crosshatch Vertical Lines	
Interval	2.7 μs
Pulse Time Position Range	At least 3.2 μs
Pulse Polarity	Positive
Number of Unblanked Pulses	16 to 17 (depends on POSITION control)
Crosshatch Pulse Duration	225 ns within 15%
Dot Pulse Duration	225 ns within 15%
Crosshatch Horizontal Lines	
Interval	17 and 18 lines alternated
Pulse Time Position Range	At least 1.4 ms
Pulse Polarity	Positive
Number of Unblanked Pulses	13 or 14 (depends on POSITION control)
Crosshatch Pulse Duration	1 line
Dot Pulse Error	2 lines per frame. Digitally determined from 3.57561149 MHz
Aspect Ratio Error	Approx 2%

POWER

Mains Voltage Range	
Low	90 V to 110 V
115 VAC Medium	104 V to 126 V
High	112 V to 136 V
Low	180 V to 220 V
230 VAC Medium	208 V to 252 V
High	224 V to 272 V
Mains Frequency Range	48 Hz to 66 Hz

Factory set for 115 Vac operation.

PHYSICAL

Dimensions (Rackmount Version)	
Height	3.47 in
Width	19.00 in
Length	19.66 in
Net Weight	20.75 lb

INCLUDED ACCESSORIES

75 Ω through-line termination (011-0103-02); 7½ ft, 3-wire power cord (161-0066-00).

R145M also includes rackmounting hardware.

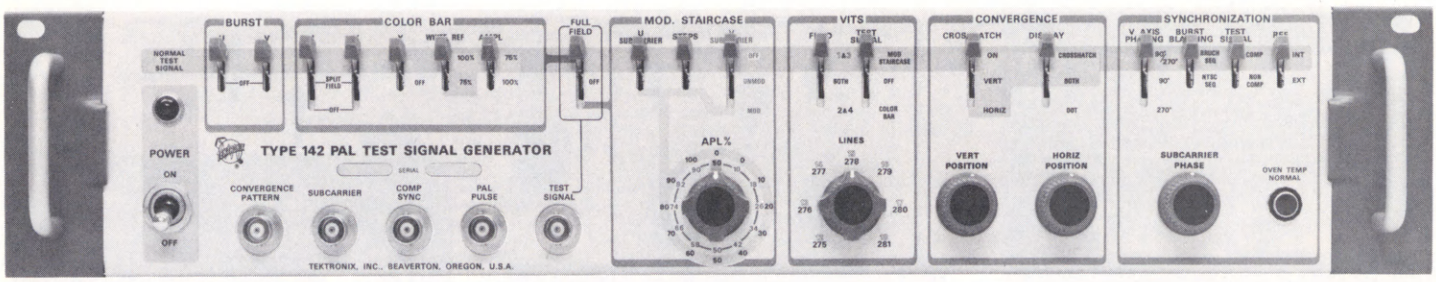
ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

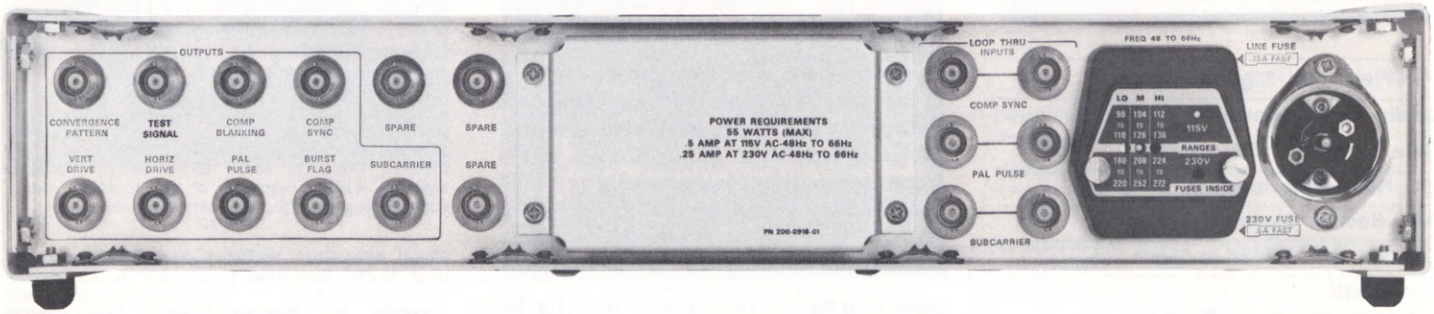
Order 145-M PAL GEN-LOCK TEST SIGNAL GENERATOR (cabinet)

Order R145-M PAL GEN-LOCK TEST SIGNAL GENERATOR (rackmount)

For applications not requiring gen-lock this unit is a master sync pulse generator and test signal source.



Rackmount version; cabinet version has carrying handle less mounting hardware.



The 142 is generally similar to the 145-M. While not equipped with gen-lock, the 142 may be externally synchronized with comp sync, PAL pulse, and subcarrier. It does not have split-field color bars, 15 Hz, and 30 Hz signal outputs.

The TEKTRONIX 142 PAL Test Signal Generator is a compact, solid-state source of high-quality television test signals for 525-line, 60 Hz field-standard PAL color TV systems. Combined in one compact unit are the test signals needed to accurately test, evaluate, and adjust laboratory and standard broadcast color video equipment. Each test signal not only strictly adheres to industry standards, but also provides additional refinements to enhance the accuracy and range of measurements which can be made.

The self-contained sync generator includes a temperature controlled color standard with excellent frequency stability. Digital integrated circuits are extensively used to achieve stability, accuracy, and reliability.

Three operating modes provide PAL color bars, 5 step or 10 step (internally selectable) staircase with APL and a 5 step staircase variable APL. A convergence pattern signal is available independent of and separate from other test signals.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

Order 142 PAL-M SIGNAL GENERATOR

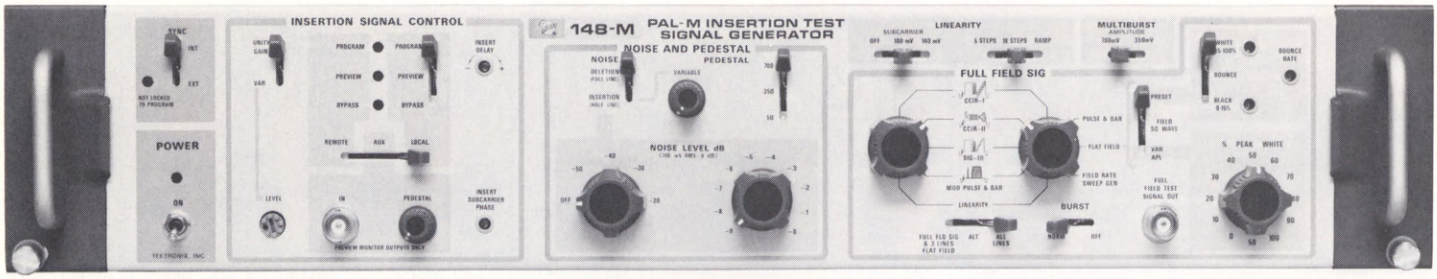
Order R142 PAL-M SIGNAL GENERATOR (rackmount)

Factory set for 115 Vac operation.

PAL-M GENERATORS

148-M

This generator supplies all the test signals commonly used for test and measurement of PAL-M video transmission systems.



Rackmount version; cabinet version has carrying handle less mounting hardware.

Full-Field Test Signals

Easily Reprogrammable

Safe In-Service ITS Insertion

ITS Noise Measurement

APL Bounce Signal

Operate with Sound-In-Syncs

Locks with

Comp or Video	**Comp Sync**
	Subcarrier
	PAL Pulse
	Burst Flag

Insertion Test Signals

The 148-M is a PAL-M television test signal generator capable of supplying all the test signals commonly used for test and measurement of video transmission systems or discrete parts of the system. The generated signals are available as full-field composite video test signals on one output, and as Insertion Test Signals inserted into the vertical blanking interval on an incoming composite video signal.

All time locations of test signals, both as to position within the line and field, are derived by digital counting from a master oscillator which, in turn, is locked to the incoming synchronizing pulses. The 148-M may be used in conjunction with the TEKTRONIX Type 142 to provide standard test signals with Gen-Locked operation.

Several different test signals may be inserted on successive lines during the vertical blanking interval, providing a simultaneous check of the complete television transmission system.

A Preview mode of operation permits observing the signal with insertion signals added before adding the ITS to the program signal.

In the event of power failure, or the actuation of a remote bypass switch, a relay switch routes the program signal around the instrument, bypassing all circuitry and thus providing fail-safe protection.

INSERTION CONTROL SYSTEM

Signal Input Level—Unity gain: ±0.5% of unity gain. Variable: 1 V p-p variable within 30%.

Program Input— 75 Ω nominal.

Program Input Return Loss—Power on: at least 46 dB to 5 MHz; power off or bypass: at least 40 dB to 5 MHz.

Outputs— 75 Ω Nominal Impedance. Return loss (all): at least 36 dB to 5 MHz. Blanking dc level: 0 Volts within 50 mV. Isolation: at least 46 dB to 1 MHz, at least 34 dB to 3.58 MHz.

Inserted Signal—Amplitude: within 1% of nominal input amplitude. Amplitude Ratio: 2T Pulse to Bar 100% ±0.5%. Mod Sin² Pulse 100% ±0.5%. Waveform Tilt: line tilt— 0.25% or less. Field rates sq wave 0.5% or less.

Differential Phase (10-90 APL, Standard Input—Program output 0.15° or less. Preview output 0.3° or less. Differential Gain (10-90 APL, Standard Input)—Program output 0.2% or less. Preview output 0.4% or less. Luminance amplitude non-linearity: 0.25% or less. Random noise output on program output: at least 75 dB (RMS) down. Residual subcarrier on non-inserted lines: at least 60 dB down. Hum or transients on non-inserted lines: at least 60 dB down. Spurious signals: during blanking at least 40 dB down, active picture, VITS: at least 60 dB down.

Signal Attenuation in Delete Mode— 2T Pulse: at least 70 dB. Subcarrier (Staircase): at least 60 dB.

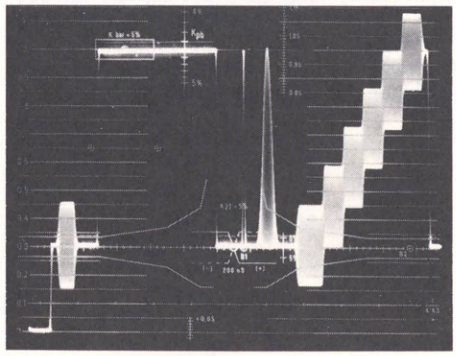
Crosstalk into Program Channel from Internal Signal— 2T Pulse: at least 70 dB down. Subcarrier (Staircase): at least 60 dB down.

Insert Delay Range—At least ±0.5 μs (1 μs total).

Frequency Response— ±1% to 5 MHz.

Unwanted Pedestal at Time of VITS Insertion— 5 mV or less.

TEST SIGNALS



CCIR-I

Bar—Amplitude: 700 mV ±1%. Rise time: 230 ns ±15% (2T); 115 ns ±15% (T).

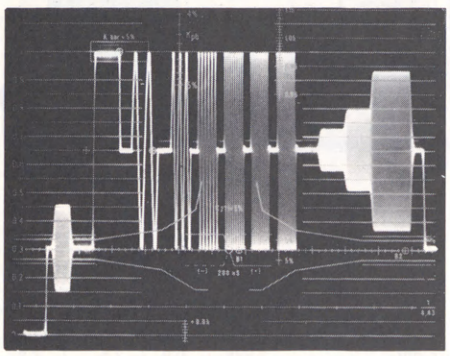
Pulse—Pulse to bar ratio: 100% ±0.5%. HAD: 250 ns ±15% (2T); 125 ns ±15% (T).

Modulated Sin² Pulse (12.5%)—Amplitude of luminance component: 350 mV ±2%. Amplitude difference of peak chrominance to peak luminance: 3.5 mV or less. Chrominance-luminance delay: 10 ns or less.

Modulated 5 Step Staircase—Luminance step amplitude: 140 mV ±1%; Rise time: 230 ns ±15%

Chrominance amplitude: 280 mV ±1% (Peak-to-Peak). Rise time: 400 ns ±25 ns.

Phase of Chrominance Components— 180° ±5° from U Axis.



CCIR-II

White Flag Amplitude— 700 mV ±1%.

Burst Amplitude— 700 mV ±1% and 350 mV ±1%.

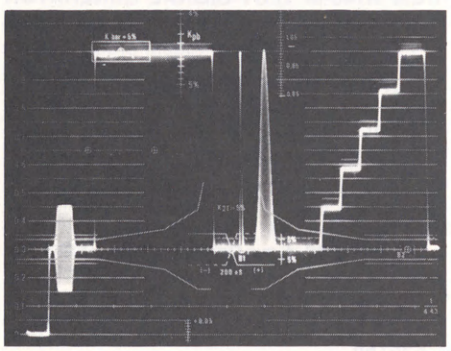
Average Level— 350 mV ±5 mV.

Burst Frequencies— 0.5 MHz ±3%, 1.0 MHz ±3%, 2.0 MHz ±3%, 3.0 MHz ±3%, 3.575 MHz ±3%, 4.2 MHz +0% and —2%.

Burst Harmonic Content— —40 dB or less.

Burst Timing—Each burst starts at 0° and consists of a whole number of cycles.

Modulated Pedestal—First chroma level: 140 mV p-p ±1%. Second chroma level: 280 mV p-p ±1%. Third chroma level: 560 mV p-p ±1%. Average level: 350 mV ±1%. Phase: 180° ±5° from U Axis. Chrominance rise time: 400 ns ±25 ns.



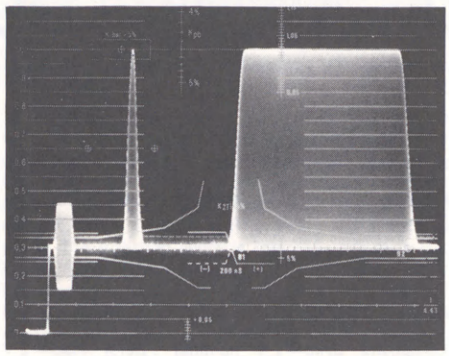
SIG-III

Bar—Amplitude: 700 mV ±1%. Rise time: 230 ns ±15% (2T); 115 ns ±15% (T).

Pulse—Pulse to bar ratio: 100% ±0.5%. Half amplitude duration: 250 ns ±15% (2T); 125 ns ±15% (T).

Modulated Sin² Pulse (12.5T)—Amplitude of luminance component: 350 mV ±2%. Amplitude difference of peak chrominance to peak luminance: 3.5 mV or less. Chrominance to luminance delay: 10 ns or less. Half amplitude duration 1.57 μs ±50 ns. Harmonic content of subcarrier: —40 dB or greater. Phase (Insertion and Full-Field): 180° ±5° from U axis.

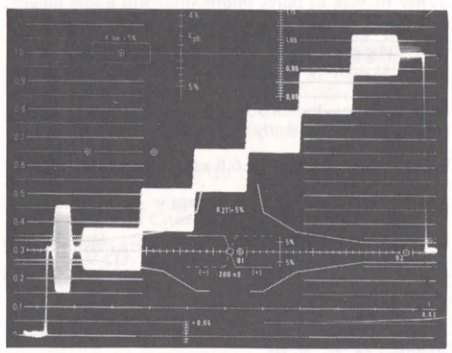
5 Step Luminance Staircase—Step amplitude: 140 mV ±15%.



MOD PULSE AND BAR

Modulated Sin² Pulse (12.5T)—Amplitude of lumuinance component: 350 mV ±2%. Amplitude difference of peak chrominance to peak luminance: 3.5 mV or less. Chrominance to luminance delay: 10 ns or less. Half amplitude duration: 1.57 μs ±50 ns.

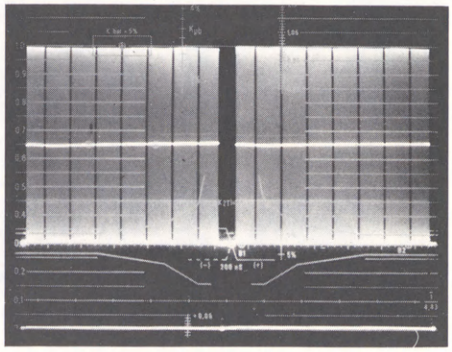
Modulated Bar—Amplitude of chrominance: 700 mV p-p ±1%. Amplitude of luminance: 350 mV ±2%. Rise time: 1.41 μs ±50 ns. Harmonic content of subcarrier: —40 dB or greater. Phase (Insertion and Full-Field): 180° ±5° to U Axis.



LINEARITY SIGNAL

Luminance Staircase—Signal step amplitude: 5 Step 140 mV ±1%; 10 Step 70 mV ±1%. Rise time (all identical): 230 ns ±15%.

Chrominance—Off: No chrominance. 100 mV 100 mV ±1% p-p. 140 mV: 140 mV ±1% p-p. Inherent differential gain: 0.5% or less. Inherent differential phase: 0.2° or less. Phase: 180° ±5° from U Axis.



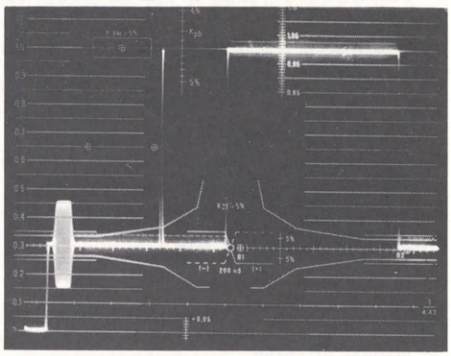
FIELD RATE SWEEP GEN

Swept Frequency Limits—Less than 20 kHz to more than 6 MHz in one field.

Markers—Modulation blanked for 1 line period 7 times per field (or 3 times per field by plug-jumper).

Modulation Amplitude— 700 mV (or 350 mV by multi-burst amplitude switch).

Pedestal Amplitude 350 mV.



PULSE AND BAR

Pulse—Pulse to bar ratio: 100% ±0.5%. Half amplitude duration: 250 ns ±15% (2%); 125 ns ±15% (T). Ringing amplitude: 0.5% or less. Ringing duration: 2 cycles or less.

Bar—Amplitude: 700 mV ±1%. Rise time: 230 ns ±15%. Duration: 26 μs/line x 152 lines.

FLAT FIELD SIGNAL

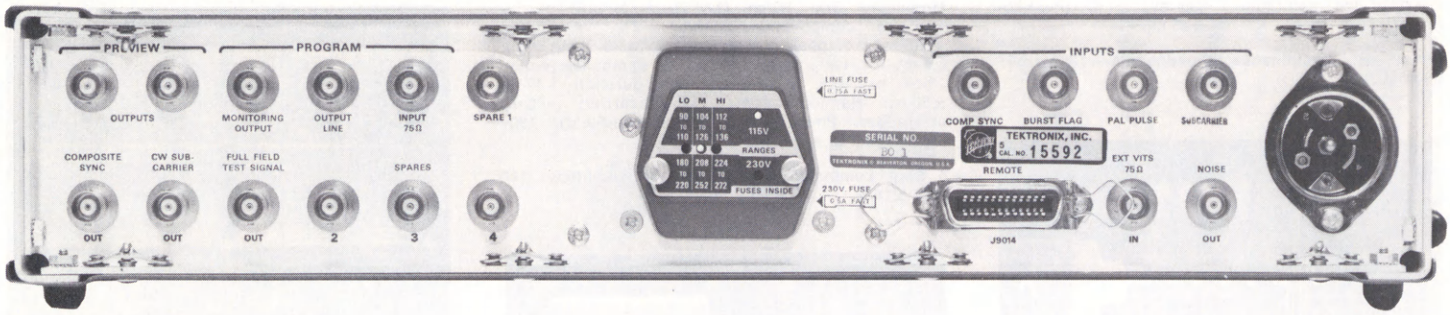
White— 85% to 100% of peak white.

Black— 0% to 15% of peak white.

Bounce—Automatic bounce between white and black.

Rate—Less than 1 sec to more than 10 sec.

Variable APL— 11 levels, each within 0.5% of nominal levels.



Field Sq Wave—Amplitude: 700 mV ±1%. Lines at white: lines 74 through 206; lines 337 through 469. Lines at blanking: all other lines.

Rise Time— 230 ns ±15%.

NOISE

Pedestal Amplitude— 50 mV: 50 mV ±5 mV. 350 mV: 350 mV ±7 mV. 700 mV: 700 mV ±14 mV.

Variable Pedestal Range— ±7 mV from nominal (14 mV total).

Noise Amplitude— —20 dB to —59 dB (0 dB = 700 mV).

Noise Attenuator Accuacy—Within 1 dB.

Noise Spectrum Bandwidth— 15 kH to 5 MHz, flat within 6 dB.

FULL FIELD TEST SIGNAL OUTPUTS

Relative Amplitudes—Within 1% at both outputs.

Return Loss— At least 36 dB to 5 MHz.

Sync Amplitude— 300 mV ±1%.

Burst Amplitude— 300 mV p-p ±3%.

Chrominance Frequency—Free run: 3.57561149 MHz ±25 Hz. Locked mode: Locked to incoming burst or external subcarrier.

COMPOSITE SYNC OUTPUT

Amplitude— 4 V negative going ±10%.

Return Loss—At least —30 dB to 3.6 MHz.

Rise and Fall Times— 115 ns ±10%.

CW SUBCARRIER OUTPUT

Disabled with loss of incoming sync or burst in INT, or with loss of any input in EXT.

Amplitude— 2 V p-p ±20% into 75 Ω.

Return Loss—At least —30 dB to 5 MHz.

Frequency—Locked to incoming burst of ext subcarrier.

INPUTS

Return Loss—At least —30 dB at 5 MHz.

Composite Sync— 2 V nominal . Burst Flag— 2 V nominal. Pal Pulse— 2 V nominal. Subcarrier— 2 V nominal.

Ext Vits In— 1 V nominal.

GEN LOCK

Input Requirements—Sync source: nominal 1 V composite video. Sync amplitude: 300 mV, within 6 dB. Burst amplitude: 300 mV, within 12 dB. Burst/sync ratio: within 6 dB.

Insert Subcarrier Phase—Range: ±10° nominal, via front-panel adjustment.

Subcarrier Lock—Lock-up amplitude: 150 mV p-p of burst information to lock. Drop-out amplitude: 50 mV or less of burst information will allow unlock.

Loss of Subcarrier Lock—Internal Subcarrier free runs at 3.57561149 MHz ±25 Hz. Subcarrier is not phase locked to sync if external sync is present.

Loss of Sync—Indicated by front-panel lamp. Instrument returns instantly to internal subcarrier.

Insert Delay Range— ±0.5 μs (1 μs total).

POWER SUPPLY

Line Voltages Selectable— 115 VAC: low 90 V to 110 V; medium 104 V to 126 V; high 112 V to 136 V. 230 VAC: low 180 V to 220 V; medium 208 V to 252 V; high 224 V to 272 V.

Crest Factor—At least 1.35. Line Frequency Range— 48 to 66 Hz.

Shipped set at 115 Volts.

DIMENSIONS AND WEIGHTS

	148		R148	
	in	cm	in	cm
Height	3.875	9.9	3.5	8.9
Width	17.875	45.5	19.0	48.0
Depth	17.125	43.6	19.625	49.9
	lb	kg	lb	kg
Net Weight	19.0	8.6	20.0	9.1
Domestic Shipping Weight	35.0	15.9	36.0	16.3
Export-packed Weight	55.0	25.0	56.0	25.4

INCLUDED ACCESSORIES

7½ ft power cable, three wire (161-0036-00); 75 Ω, BNC termination (011-0103-02); 2 each BNC- adapters (103-0030-00). R148 includes rackmounting hardware (351-0195-00).

Order 148-M TEST SIGNAL GENERATOR

Order R148-M TEST SIGNAL GENERATOR (rackmount)

NOISE MEASUREMENT FILTERS

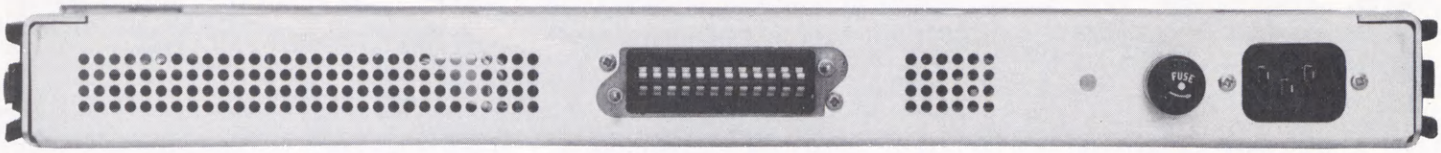
External filters are required with the 148-M Generator when making noise measurements.

Order:
015-0212-00 Low-Pass 4.2 MHz 525/60

Order:
015-0214-00 Noise-Weighting 4.2 MHz 525/60

This random noise measuring test set can be used in service or out of service.

This 1430 is a rackmounted generator complete with mounting hardware.



In-Service Testing

Out-Of-Service Testing

Program Material Protected By Fail-Safe Provisions

525/60 or 625/50

The 1430 Random Noise Measuring Set provides random noise measurement capabilities on an in-service basis using the spatially adjacent noise matching technique with a waveform monitor. A program channel is provided for deletion of VITS and/or noise on selected lines in the vertical blanking interval and a monitor channel is provided for making measurements with a waveform monitor. The 1430 consists of two sections. One permanently mounted in the rack contains inputs and outputs and provisions for protecting program material. The second section, only 1¾ inches high, contains circuitry and controls which are easily removed without cable disconnection.

PROGRAM CHANNEL

The program channel has a 75 Ω input impedance, unity gain and output impedance of 75 Ω. No program impairment is introduced. A relay provides program signal continuity if the 1430 loses power. All deletion parameters are controlled by internal programming readily changeable within the 1430. Deletion of up to any three lines between 10 and 21 in either or both fields is provided. The deletion may be varied between the first half, second half, or full active portion of the video line. A pedestal may be inserted in the deleted portion of a line at 10, 50, or 100 IRE levels.

MONITOR CHANNEL

The monitor channel has an output independent from program for comparing the noise on the incoming signal against the noise from the internal noise generator on a waveform monitor. Monitor channel parameters are determined by front-panel controls. Three operating modes are provided: VITS, Full Field, and Out-of-Service.

In the VITS mode, any line between lines 10 and 21 in either or both fields may be selected for insertion of the reference noise. The Full-Field mode provides insertion on all active lines.

The Out-of-Service mode is intended for making measurements on sources that do not have composite sync, in particular, transmission circuits not carrying signals at the time this test is conducted. Horizontal sync is added for synchronization of the waveform monitor with the insertion time in the Out-of-Service mode. The insertion width is internally set at 26 μs. Delay between insertion and sync is controlled by Delay adjustment in all modes. The insertion pedestal level is controlled by a switch and a potentiometer covering a range of 0 - 100 IRE.

Monitor channel gain control, with a ±3 dB range, allows normalizing the signal for 1 V p-p signal so that noise measurement relative to 1 V may be made. The internal noise-weighting filter may be switched in or out from the front panel for evaluation of the spectral content of the incoming noise. The weighting filter is in the monitor channel and does not affect the program output.

Both the noise-weighting filter and the low-pass filter are on separate etched circuit boards and can easily be changed for different television systems, e.g., 625/50 and 525/60 standards require different filters, the 1430 will operate (with appropriate filters) on both standards. The 1430 is shipped equipped for 525/60. The 1430 Opt. 1 is equipped for 625/50.

Option 2 adds the weighting filter described in CCIR Document CMTT/1048-E to either the standard 1430 or to the 1430 Option 1. Insertion losses in table are approximate.

FREQUENCY (MHz)	1	2	3	4	5
INSERTION LOSS (db)	5.9	10.2	12.0	13.0	13.6

PROGRAM CHANNEL CHARACTERISTICS

Signal Input Level—1 volt nominal.

Input Impedance—75 Ω nominal.

Input Return Loss—POWER ON is at least 46 dB to 5 MHz. POWER OFF or BYPASS is at least 40 dB or 5 MHz.

Output Impedance (Operating)—75 Ω nominal.

Output Return Loss (All)—At least 30 dB to 5 MHz.

Output Blanking, DC Level—0 V within 50 mV, for blanking pulses.

Inserted Pedestal Level—Adjustable to 100, 50, 10, or 0 IRE.

2 T Pulse to Bar Amplitude—Within 0.25%.

Mod Sin² Pulse (Chrominance and Luminance)—100% within 0.5%.

Waveform Tilt, Field Rate Squarewave—0.5% or less, 26 μs Bar, 0.5% or less.

Differential Phase (10% - 90% APL, Standard Input)—Program output, 0.15° or less.

Differential Gain (10% - 90% APL, Standard Input)—Program output, 0.2% or less.

Line Time Amplitude Nonlinearity (10% - 90% APL, Standard Input)—0.5% or less.

Random Noise—Program output, at least 75 dB (RMS) down (using weighted and low pass filters, 5 MHz).

Hum or Transients on Noninserted Lines—At least 60 dB down (using weighted and low pass filters, 5 MHz).

Spurious Signals During Blanking Lines—At least 40 dB down, low pass (5 MHz).

Signal Attenuation in "Delete" Mode—2 T pulse, at least 70 dB down; subcarrier (color bars), at least 60 dB down; insertion pedestal 10, 50, and 100 IRE, first half, second half, or entire line (up to 3; 10 to 21) or full field.

Unwanted Pedestal At Time of VITS Insertion—0.7 IRE or less.

Time Jitter—5 ns or less.

NOISE

Noise Measurement Signals—Pedestal Amplitude, 10 IRE, 50 IRE, and 100 IRE

Pedestal Level—(Insertion mode only) Delay is 10 to 50 μs.

Noise Amplitude—−20 dB to −59.5 dB (0 dB = 700 mV RMS).

Noise Attenuators—Absolute amplitude is within 1 dB.

Noise Spectrum—Energy/unit bandwidth is flat within 6 dB, 15 kHz to 5 MHz.

Output Impedance—75 Ω nominal.

Output Return Loss—At least 30 dB.

Noise Weighting and Low Pass Filter — Per CCIR recommendation 421-2.

OTHER CHARACTERISTICS

Line Voltage Range—115 Vac is 90 V to 132 V. 230 Vac is 180 V to 264 V. Standard 1430 factory set at 115 Vac. 1430 Option 1 factory set at 230 Vac.

Max Line Current—.25 A.

Max Power Consumption—30 W.

Line Frequency Range—48 to 66 Hz.

INCLUDED ACCESSORIES

Three wire power cable (161-0066-00); 1 pr slide guide (351-0331-01); cover program front panel (200-1481-00).

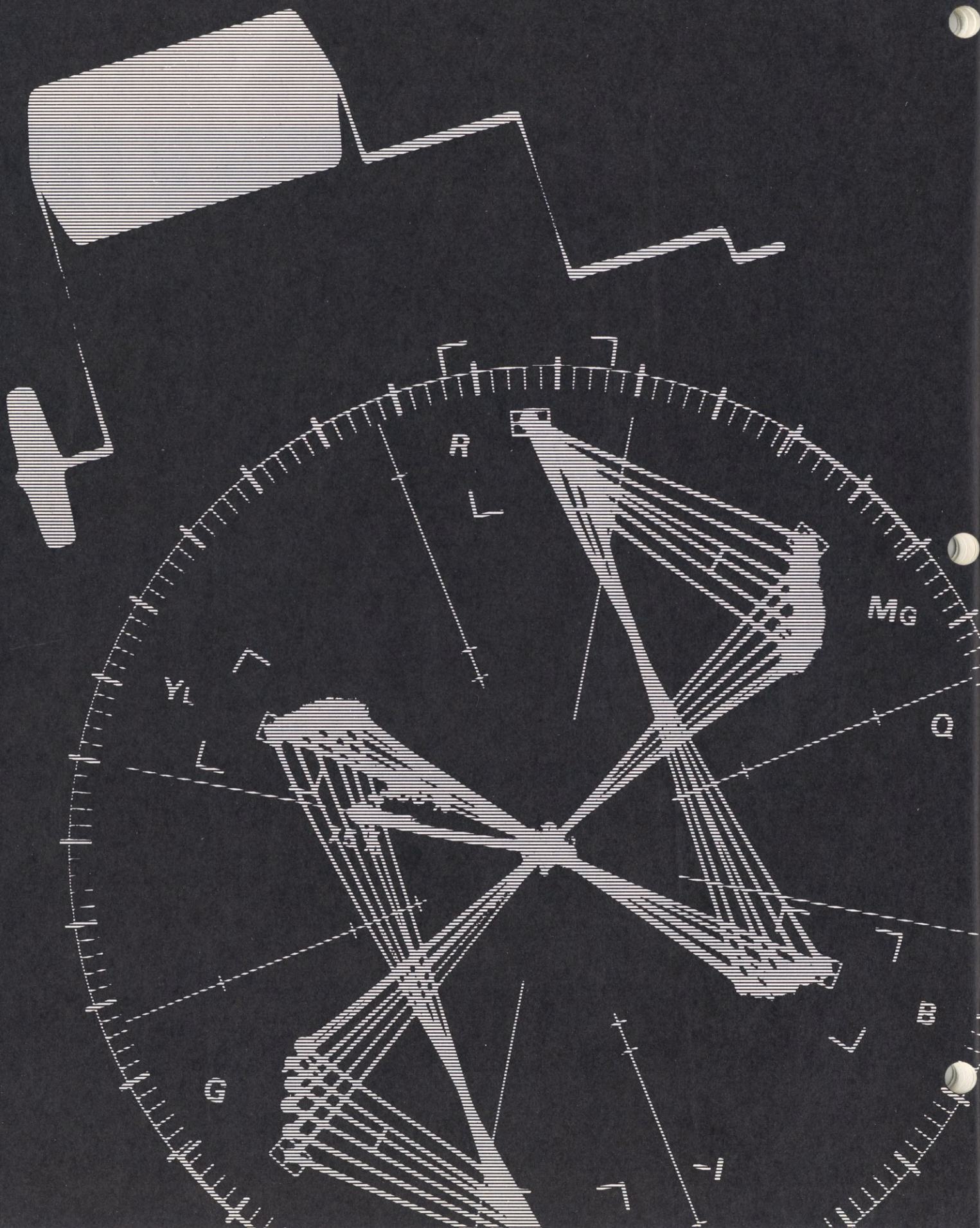
ORDERING INFORMATION

1430 Random Noise Measuring Set (525/60)

1430 Opt. 1 Random Noise Measuring Set (625/50)

Option 2 (adds CMTT/1048E weighting filter)

AUTOMATIC VIDEO CORRECTORS



The Television Production team's efforts insure that the picture starts out right . . . Automatic Video Correction assures that the picture continues to be right.

Broadcast

On the network feed.

On remote feeds into the plant.

At the master switcher output.

At the transmitter input.

Cable

In local origination.

Where imported signals are demodulated to baseband before modulation onto a new carrier.

Satellite Systems

Correction of video signals at transcoding points, to and from different color systems.

Television Receiver Design

Changing burst gain and introducing burst phase errors for testing automatic color control circuits.

WHY SHOULD YOU USE AUTOMATIC VIDEO CORRECTION?

Automatic Correction assures that your picture continues to be what you want it to be. The TEKTRONIX 1440 and 1460 Automatic Video Correctors take the work out of video signal quality control . . . with FULLY AUTOMATIC CORRECTION of video gain, chrominance to luminance gain ratio, black level (set up), chroma phase, burst amplitude, and sync amplitude errors. With a 1440 or 1460 in your facility, the quality of program signal is rigidly maintained. Ordinary changes and even many severe distortions are automatically corrected, freeing engineering people from the task of regularly readjusting controls. Attempting to keep up with varying conditions with manual correction is no longer necessary . . . so why do it? Who wants to regularly adjust proc amp controls when the corrector does it all automatically?

HOW DOES AUTOMATIC CORRECTION WORK?

The 1440 and 1460 are in-line correcting amplifiers using the Vertical Interval Reference Signal (VIRS) for NTSC systems or ITS line 330 for PAL systems as correction reference signals. Correct the reference signal and the full field signal is thereby corrected too . . . that is the essence of the automatic correcting action.

The corrector samples six parameters of the reference signal in the vertical interval and then automatically changes its operating characteristics until correct values for the reference signal are achieved. The full field signal is simultaneously corrected by the same automatic changes that correct the reference signal.

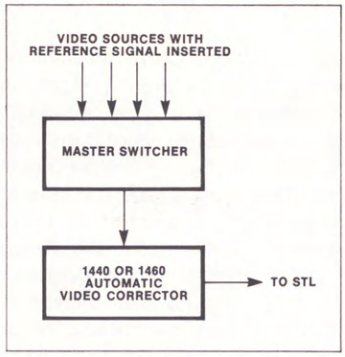
As a corrector (open loop)—The 1440 or 1460 monitors the video signal at its program line input and automatically corrects distortions as needed. Use it manually when a reference is not present on the video signal.

As a precorrector (closed loop)—The 1440 or 1460 monitors the video signal at a point after its output and precorrects for distortions caused by devices in the signal path *after* the corrector. As in open loop, it can be used manually when a reference signal is absent.

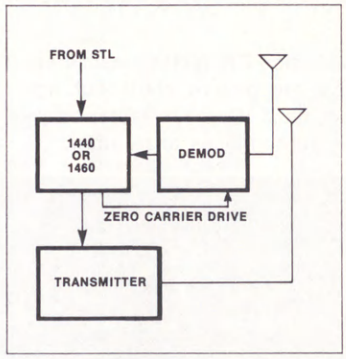
As a source of controlled distortion—each of the "corrections" can be used to over correct and thus *produce* controlled distortions. These controlled distortions can be used for training and simulation of system problems. The Remote Control Unit is recommended for this function.

For quick check monitoring or long term logging—The corrector provides six analog outputs useful for display of the amount of each of the six corrections made by the corrector. For this use the Remote Monitor Unit is a very useful accessory. Each of the six meters in the Remote Monitoring Unit displays the amount of distortion of the uncorrected input signal in percentage of gain or degrees of phase.

The analog outputs of the 1440 or 1460 can be used to chart long term variations for detailed analysis of system performance and location of those unpredictable problems that never seem to occur when you are visually monitoring.

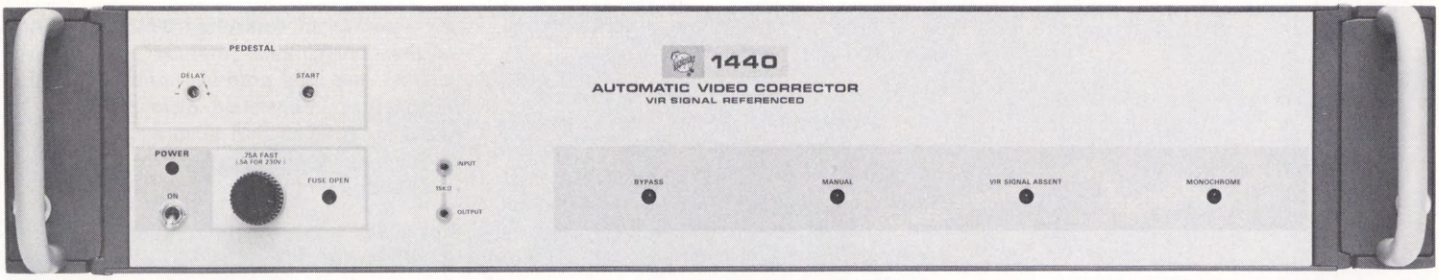


Open-Loop Operation

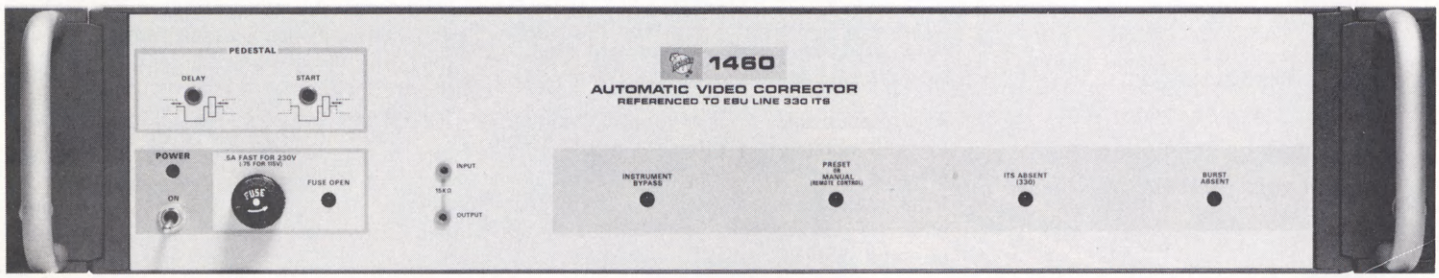


Closed-Loop Operation

FUNCTION	SYSTEM	INSTRUMENT
AUTOMATIC VIDEO CORRECTION	NTSC 525/60	1440
	PAL 625/50	1460
REMOTE MONITORING OF THE APPLIED CORRECTIONS	NTSC	015-0239-00
	PAL	015-0239-01
REMOTE CONTROL OF THE MODES AND PARAMETERS OF THE AUTOMATIC CORRECTOR	NTSC	015-0240-00
	PAL	015-0240-01
REFERENCE SIGNAL SOURCE	NTSC	1441
		147A
		149A
	PAL	1461
		148
CALIBRATED CHROMINANCE LEVEL CORRECTOR	NTSC	1478
	PAL	1478
For measurement and manual correction of relative chrominance/ luminance gain errors.	PAL-M	1478

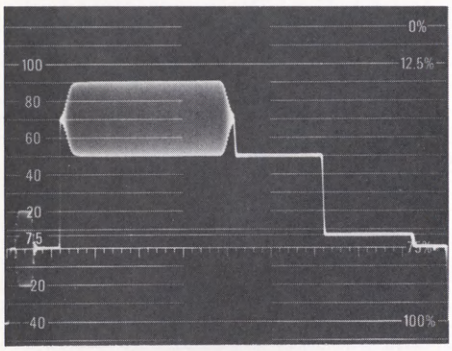


1440 NTSC Automatic Video Corrector

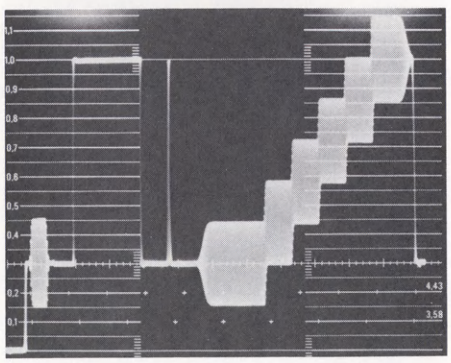


1460 PAL Automatic Video Corrector

The Television Production team's efforts insure that the picture starts out right . . . The Automatic Video Corrector assures that the picture continues to be right.



Vertical Interval Reference Signal (VIRS)



EBU Insertion Test Signal Line 330

The Automatic Video Corrector samples six parameters of the Reference Signal in the vertical interval and then automatically changes its operating characteristics until correct values for the Reference Signal are achieved. Distortions in the full field signal are simultaneously corrected by the automatic changes that restore the Reference Signal to its original characteristics. The corrector has no front or rear panel controls other than the power switch and the preset pedestal width adjustments. Operating modes other than full automatic correction are indicated by front panel lights. Oscilloscope test points are provided for program input and program output.

Bypass

Indicates that the program video is being bypassed to the program output without correction.

Bypassing occurs when activated by the Remote Control Unit, or when the corrector is removed from the rear interface unit.

Manual

Indicates that the corrector has either been remotely switched to manual control; or has reverted to a preset correction, due to loss of reference signal.

ITS Absent (VIR Signal Absent) Indicates the loss of the reference signal on the incoming program video. Preset operation will continue with ITS (or VIRS) absent.

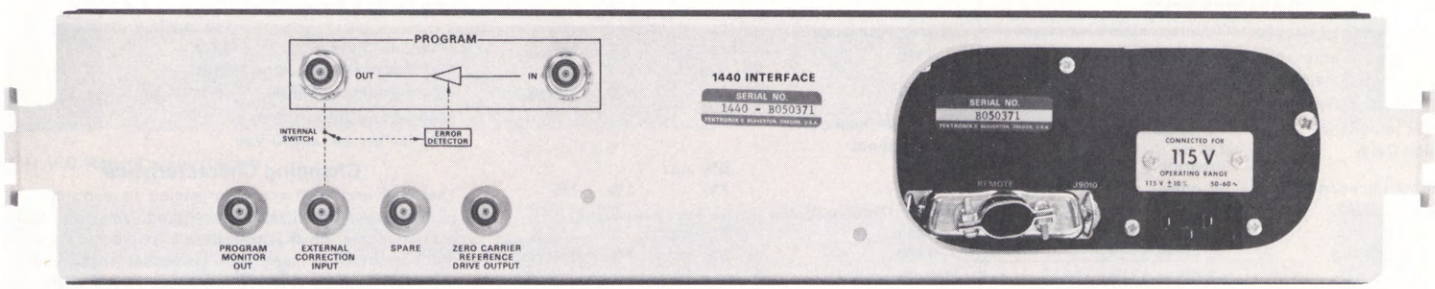
Burst Absent (Monochrome)
Indicates the loss of burst from the incoming program video. Monochrome parameters will be corrected with reference signal present.

The TEKTRONIX 1440 VIRS Automatic Video Corrector is an "in-line" NTSC processing amplifier, which uses the VIRS (Vertical Interval Reference Signal) to automatically correct video gain, chrominance to luminance gain ratio, setup level, burst phase relative to chroma (hue), burst gain, and sync gain.

Video gain correction is referenced to the 50 IRE level of the VIRS. Chrominance to luminance gain ratio and burst phase corrections are referenced to the amplitude and phase of the VIRS chrominance respectively. Setup level correction is referenced to the 7.5 IRE level of the VIRS. Sync and burst gain corrections are controlled respective to their standard amplitudes.

The 1460 Automatic Video Corrector is an "in-line" PAL processing amplifier which uses EBU Insertion Test Signal Line 330 as a reference to automatically correct video gain, chrominance to luminance gain ratio, black level, chroma phase, burst amplitude, and sync amplitude.

The 1460 samples peak of white bar for



The corrector interface remains in the rack when the corrector is removed (see photo below).

overall video gain correction. Blanking level is sampled for black level correction. The third, fourth, and fifth chrominance risers are sampled for chroma gain and chroma phase correction. The 1460 samples sync and burst, and corrects them to their standard 300 mV amplitudes.

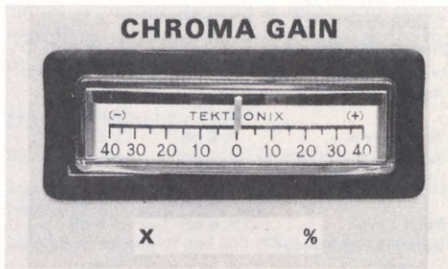
Since the 1440 and 1460 are automatic they will continue to operate as unity gain devices without distorting program video if reference is lost. If burst is lost with reference present monochrome correcting will continue. An excellent source of reference is the 1441 for NTSC Systems, or the 1461 for PAL Systems.

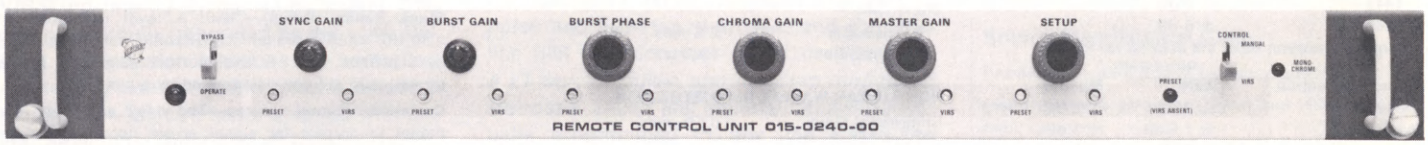
Program Protection and Operating Considerations

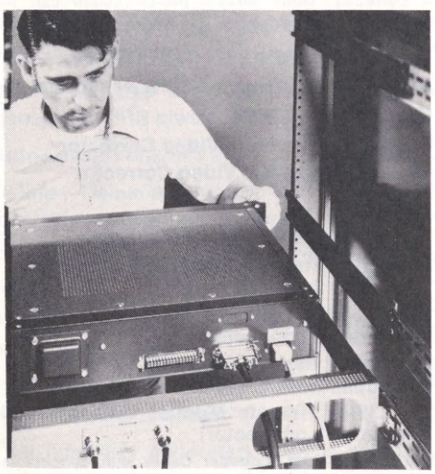
In most cases the corrector operation is quite straightforward. Distortions that change the reference signal will cause correcting action to occur.

In precorrection applications such as in transmitter closed loop precorrection, processing amplifiers should not be used within the loop.

The amounts of correction for each control parameter shown by the optional Remote Monitor Unit for the 1440, 015-0239-00. (For 1460, use Remote Monitor Unit 015-0239-01).







Program continuity is protected even when the corrector is removed from the rack. The interface remains in place.

When sound-in-syncs is present, automatic sync correction can be disabled. Manual control of sync gain can be substituted with the Remote Control Unit.

Continuity of the program line, through the Automatic Corrector, is protected by a bypass relay. The relay automatically bypasses the program line through a delay line to maintain a constant program delay line in the event of a power failure. The program delay in all modes is 145 ns.

The corrector may also be removed from the equipment rack with just minimum instantaneous disruption of the program line; no time difference between the corrected or bypassed signal will be observed.

Manual corrections can be produced by the optional Remote Control Unit for 1440, 015-0240-00. (For 1460, use Remote Control Unit 015-0240-01).

CHARACTERISTICS

(Apply to both 1440 and 1460 unless otherwise stated.)

A 10 minute warm-up period is required for a properly calibrated instrument to achieve stated accuracies.

INPUT TO OUTPUT

Input Impedance	75 ohms
Video Delay	145 ns (operating or bypass)
Output Impedance	75 ohms
Return Loss	
Input	
Operating	46 dB to 5 MHz
Bypass	40 dB to 5 MHz
Output	36 dB to 5 MHz
Program Monitor Out	36 dB to 5 MHz
External Correction Input	46 dB to 5 MHz
External Correction Input Impedance	75 ohms
Zero Carrier Reference Drive Output	1 volt into 75 ohms (polarity reversible)
Program Monitor Out	
Output Impedance	75 ohms

CORRECTION RANGES

Max Correction Ranges	Auto	Manual
Video Level	± 6 dB	± 6 dB
Sync Level	± 3 dB	± 6 dB
Chrominance/ Luminance Gain	± 3 dB	± 3 dB
Burst Level	± 6 dB	± 6 dB
Burst/Chrominance Phase	± 25°	± 25°
Black Level Setup		
1440	± 10 IRE	± 10 IRE
1460	± 10% (of peak white)	± 10% (of peak white)

Zero Carrier Tracking Range	
1440	± 6 dB
1460	± 6 dB
Automatic Correction Rate	0.3 second for 90% correction

Reduced Correction	Auto	Manual
Video Level	± 2 dB	± 2 dB
Sync Level	± 1.5 dB	± 3 dB
Burst Level	± 3 dB	± 3 dB
Black Level Setup		
1440	± 5 IRE	± 5 IRE
1460	± 5% (of peak white)	± 5% (of peak white)

DC Error Signal Outputs	Video Gain, Sync Gain, Burst Gain, Relative Chrominance Gain, Burst Phase, Setup, and in the 1460, Zero Carrier Offset
Source Impedance	10 k ohms
Open Circuit Voltage	10 volts

CHROMINANCE/LUMINANCE GAIN CORRECTION

	+3 dB	0 dB	−3 dB
2T Pulse/Bar Ratio			
1440	110% max		92% min
1460	115%	100%	88%
T Pulse/Bar Ratio			
1440	125% max		85% min
1460	128%	100%	82%

	+3 dB	0 dB	−3 dB
T Step Rise Time			
1440	95 ns min		155 ns max
1460	80 ns min	100 ns	120 ns max
2T Pulse Preshoot or Overshoot			
1440	5% max		
1460	7%	1%	7%
T Step Overshoot			
1440	5% max		
1460	8%	1%	8%
Chrominance/ Luminance Delay			
1440	10 ns max		10 ns max
1460	10 ns	5 ns	10 ns

CLAMPING

Fast Clamp	
Level Change (80% APL change; 10 to 90% or 90 to 10%)	Recover to within 5%, without overshoot, in 1 H or less
Hum Reduction	40:1 or more reduction of 1V hum on the input signal
Field Time Tilt Correction	At least 25:1 (up to 25% tilt on input signal)
Video Signal to Random Noise Ratio (unweighted)	At least 60 dB to 5 MHz
Spurious Subcarrier	−60 dB
Relative Signal Timing Errors	
Sync to Burst	None
Burst to Video	None
Jitter	
Sync to Video	None
Burst	None

LINEAR WAVEFORM DISTORTION

Field Time	0.5% max
Line Time	0.5% max
Short Time	
T Pulse/Bar	2% max
2T Pulse/Bar	1% max

NON-LINEAR WAVEFORM DISTORTION

Differential Gain (10-90% APL)	0.5% max
Differential Phase (10-90% APL)	0.5% max
Dynamic Gain	
Picture (10-90% APL)	0.5% max
Sync (10-90% APL)	0.5% max
Chrominance/ Luminance Intermodulation	0.5% max
Line Time Non-Linearity	0.5% max

PHYSICAL CHARACTERISTICS

Length	16.22 in. (41.20 cm)
Width	19.00 in. (48.26 cm)
Height	3.47 in. (8.81 cm)
Net Weight	16.69 lbs. (7.57 kgm)
Shipping Weight	
Domestic	24.14 lbs. (10.95 kgm)
Export (approx)	37.00 lbs. (16.78 kgm)

POWER REQUIREMENTS

Line Voltage Range	90 to 136 V ac; 180 to 272 V ac
Max Line Current	0.5 A
Max Power Consumption	35 W
Line Frequency Range	48 to 66 Hz

1440 factory set at 115 Vac.
1460 factory set at 230 Vac.

Changing Characteristics

The 1440 and 1460 are programmed to perform corrections over broad ranges specified. You can easily change some of the operational characteristics of the corrector to meet your individual requirements with the jumpers that are included. If you prefer, a narrower range of corrections can be programmed.

Sync Loss Bypass—The corrector is preset to allow switching between signal sources on the program line, without causing the corrector to go into the bypass mode. Changing a jumper enables the corrector to automatically go to bypass mode upon loss of sync.

Reference Signal Line Selector—1440: A plug jumper allows line 15 through 21 to be selected for VIR Signal Detection. 1460: Line 330 is preset. Other ITS lines can be selected with a jumper.

Reference Signal Field Selector—The corrector is preset for both fields. Field one only or field two only can be selected with a jumper.

Clamp Time—Clamping after ten lines is preset. Clamping after one line can be selected with a jumper.

Video Amplitude Range—Video correction of ±6 dB is preset. ±2 dB can be selected by a jumper.

Sync Amplitude Range—A sync correction range of ±3 dB is preset. ±1.5 dB can be selected by a jumper.

Burst Amplitude Range—A burst correction range of ±6 dB is preset. ±3 dB can be selected by a jumper.

Burst Phase Correction Disable—Burst phase correction is preset. Correction can be disabled by a jumper.

Black Range (Setup)—1440: A level correction of ±10 IRE units is preset. ±5 IRE units can be selected by a jumper. 1460: A level correction of ±70 mV is preset. ±35 mV can be selected by a jumper.

Correction Signal Source—The 1440 and 1460 are preset to correct for signal errors occurring before the corrector. Down stream pre-correction can be selected by a jumper.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

1440 NTSC Automatic Video Corrector
1460 PAL Automatic Video Corrector

OPTIONAL ACCESSORIES

015-0240-00 Remote Control Unit for 1440
(Includes 2 connectors)

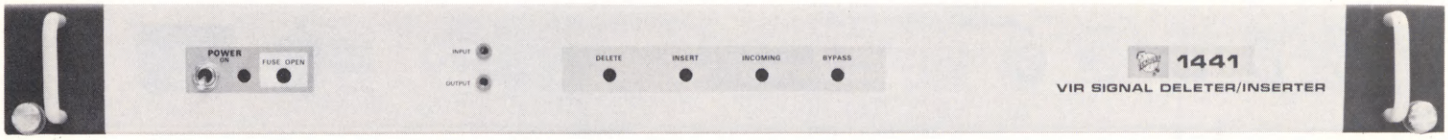
015-0239-00 Remote Monitor Unit for 1440
(Includes 1 connector)

015-0240-01 Remote Control Unit for 1460
(Includes 1 connector)

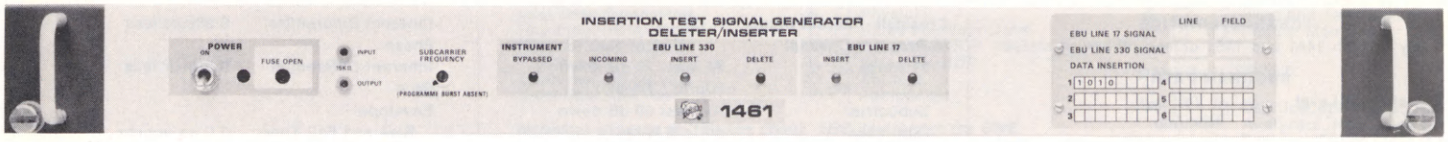
015-0239-01 Remote Monitor Unit for 1460
(Includes 1 connector)

012-0131-00 6 Foot Extender Cable with connectors for interconnection between the 1440 (1460) and the remote control and remote monitor units.

012-0637-00 3 Foot Extender Cable with connectors, for interconnection between the 1440 (1460) chassis and the rear rackmounting section.



1441 VIR Signal Deleter/Inserter



1461 Insertion Test Signal Generator Deleter/Inserter

Remote Control

Program Protection

Function Indicators

The 1441

The 1441 VIR Signal Deleter/Inserter provides an economic means for insertion of the Vertical Interval Reference Signal (VIRS) on line 19 of the video signal. The VIRS is internally generated by the 1441. Deletion and insertion functions are controlled remotely. The 1441 VIR Signal Deleter/Inserter provides an economic means for insertion of the Vertical Interval Reference Signal (VIRS) on line 19 of the video signal. The VIRS is internally generated by the 1441. Deletion and insertion functions are controlled remotely by user provided ground closures through a 24-pin connector shipped with the unit. Selectable functions include:

Passive—Line programmed for VIRS passes without disturbance.

Insert—Deletion and insertion of internally generated VIRS always occurs.

Auto—Insert only if VIRS is not present.

Delete—Delete anything on line programmed for VIRS, no insertion occurs.

Front-panel lamps indicate the following conditions:

Presence of a VIRS on the incoming composite video.

That any signal on the line programmed for VIRS is being deleted.

That internally generated VIRS is being inserted in the line programmed for VIRS.

Incoming composite video bypassed to output without disturbance.

Program Protection 1441 and 1461

In the event of power failure, actuation of a remote bypass switch, or the removal of the 1441 or 1461 from the rack, a relay switch in the Interface will route the program signal so that program line continuity is maintained. Signal delay remains unchanged.

The 1461

The 1461 is an Insertion Test Signal Generator Deleter/Inserter for 625/50 PAL television. It is capable of inserting either or both of two internally-generated insertion test signals (ITS). These test signals are the EBU line 17 insertion test signal consisting of a 2T bar, 2T pulse, 20T modulated pulse and five-step staircase; and the EBU line 330 insertion test signal consisting of a 2T bar, 2T pulse, and five-step modulated staircase. These test signals can be individually programmed to any line within the vertical interval.

A 48-bit Source Identification Code is available for the 1461 (Option 1). Like the test signals, the code can be programmed to any line in the vertical blanking interval. The code itself is programmed with internal jumpers. Code bit widths are 1 μsec with 200 nanosecond rise and fall times. Code bit amplitude is adjustable from 40% to 100% of peak white. Insertion of the code information into the video signal is controlled through the 1461 rear panel remote connector. The code configuration may be noted on a front panel plate provided as part of the option.

Remote Control Modes

The following operating modes can be remote-controlled through the 24-pin remote connector.

Instrument Bypassed — Incoming program signal is routed through a relay and delay-matching network in the Interface to the output connector.

Line 330 Signal Control

Passive—Program signal passes unaffected.

Insert—Deletes incoming line 330 signal and inserts internally-generated test signal.

Auto—Inserts only if line 330 ITS is not present.

Delete—Deletes incoming ITS.

Line 17 Control

Passive—Program signal passes unaffected.

Enable—Inserts line 17 or follows line 330 depending on internal jumper.

Source Identification Code

Passive—Program Signal passes unaffected.

Insert—Deletes incoming signal and inserts SID signal.

Delete—Deletes incoming signal.

Front Panel Indicators

Instrument Bypassed

LED: indicates, when power is on, that the incoming video signal is bypassed in the interface to the program output.

EBU Line 330

INCOMING
LED: indicates Line 330 ITS present on incoming video.

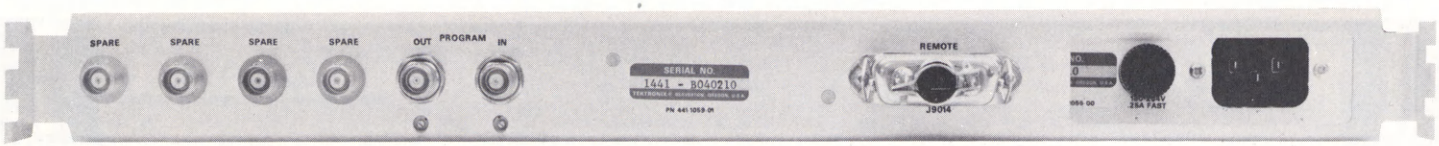
INSERT
LED: indicates Line 330 ITS is inserted on selected line.

DELETE
LED: indicates incoming ITS is deleted.

EBU Line 17

INSERT
LED: indicates Line 17 ITS is inserted on selected line.

DELETE
LED: indicates incoming ITS is deleted.



The interface remains in the rack insuring program continuity when the Deleter/Inserter is removed (1441 Interface shown here).

CHARACTERISTICS

Apply to both 1441 and 1461 unless otherwise stated.

PROGRAM PATH

Signal Input Level	1 Volt p-p Nominal
Program Gain	
1441	Unity within 0.5%
1461	Unity within 1%
Input Return Loss	
Power On	
1441	46 dB to 5 MHz
1461	At least 30 dB at 7 MHz
Power Off or Bypass	
1441	50 dB to 5 MHz
1461	At least 30 dB at 7 MHz
Input Impedance	75 Ω nominal
Output Return Loss	
1441	30 dB to 5 MHz
1461	At least 30 dB at 7 MHz
Output Impedance	75 Ω nominal
Output Blanking	
DC Level	0 V ± 50 mV
Amplitude Ratio	
2T Pulse to Bar	100% ± 0.25%
Mod Sin² Pulse	100% ± 0.50% (Chrom. to Lum.)
Waveform Tilt	
Line Tilt	
26 μs Bar (1441)	Less than 0.25%
25 μs Bar (1461)	Less than 0.50%
Field Rate Square Wave	Less than 0.50%
Differential Phase	
(10%-90% APL, Nominal Input)	0.15° or less (0.30° or less at + 3 dB for 1461)
Differential Gain	
(10%-90% APL, Nominal Input)	0.2% or less (0.4% or less at + 3 dB for 1461)
Line-time Nonlinearity	0.25% or less. (Unmodulated staircase)
Random Noise Output	At least 75 dB (RMS) down. (Weighted up to 5 MHz)
Non-Inserted Lines	
Residual Subcarrier	At least 60 dB down (1441, 3.58 MHz bandpass. 1461, 4.43 MHz bandpass.)
Hum or Transients	At least 60 dB down (Up to 5 MHz)
Spurious Signals	
1461	
During Blanking	At least 40 dB down (Up to 5 MHz)
During ITS and Active Picture Lines	At least 60 dB down (Up to 5 MHz)
1441	
Non-Inserted Lines	At least 40 dB down (Up to 5 MHz)
Signal Attenuation In Delete Mode	
2T Pulse	At least 70 dB (Up to 5 MHz)
Subcarrier (Color Bars)	At least 60 dB
Crosstalk Internal Signal to Program Channel	
2T Pulse	At least 70 dB down (Up to 5 MHz)
Subcarrier (Staircase)	At least 60 dB down up to 5 MHz
Time Jitter	5 ns or less
Video Delay	
1441	48° within 5° at subcarrier frequency
1461	60° ± 5° at color subcarrier frequency
Frequency Response	±1% to 6 MHz; + 1% to −6.5%, 6 MHz to 10 MHz
1461	
Unwanted Pedestal at Time of Test Signal Insertion	
1441	0.7 IRE or less
1461	5 mV or less
Subcarrier Lock (1461)	
Pull In	At least 150 mV p-p Burst
Hold In	At least 50 mV p-p Burst

1441 VERTICAL INTERVAL REFERENCE SIGNAL

VIR SIGNAL	
Chrominance	
Amplitude	40 IRE within 0.4 IRE
Phase	180° within 0.5°
Envelope Rise Time	1 μs
Phase Change with Burst Amplitude Change	1° or less (Burst amplitude varied from 40 IRE to 20 IRE or to 80 IRE)
Phase Change with Burst Frequency Change	1° or less (Burst frequency changed + 10 Hz or − 10 Hz from 3.579545 MHz)
Luminance	
Setup Level	7.5 IRE within 0.5 IRE
Gray Level	50 IRE within 0.5 IRE
Chroma Pedestal	70 IRE within 0.5 IRE

1461 INSERTED TEST SIGNALS

Inserted Signal Amplitude	±1% or nominal, 700 mV
Inserted Signal Blanking Adjustment Range	At least ±0.5 μs
Linearity Staircase Signal	
Luminance	
Amplitude	Within ±1% of Luminance-bar amplitude
Line-time non-linearity	The difference in amplitude between the largest and smallest risers is less than 0.5% of the largest amplitude
Rise Time	200 ns ±15% (2T filter)
Number of Risers	5
Chrominance	
Frequency	
Burst Absent	4.43361875 ±10 Hz
Burst Present	Frequency locked to burst
Amplitude	280 mV ± 1%
Inherent Differential Phase	0.2% or less
Inherent Differential Gain	0.5% or less
Envelope	
Rise and Fall Time	1.0 μs approx
Phase	60° ± 0.5°
2T Pulse	±1% of luminance-bar amplitude
Pulse to Bar Ratio	±1% of luminance-bar amplitude
HAD	200 ns ± 10 ns
Ringing	
Amplitude	0.5% or less of pulse amplitude
Duration	4 cycles or less
2T Bar	
Rise Time	200 ns approx (2T filter)
Amplitude	700 mV ± 1%
Tilt	Less than 0.5% of bar amplitude, 10 μs period
Mod Sin² Pulse (20T)	
Amplitude	Within ±1% of luminance bar amplitude
Chrominance/ Luminance Gain Inequality	0.5% or less
Chroma-Luminance Delay	Less than 10 ns
HAD	2.0 μs ± 0.06 μs
Residual Subcarrier on Insert Line	Less than 3.5 mV
Harmonic Content of Subcarrier	40 dB down
Phase	60° ± 5°

POWER SUPPLY

Line Voltage	
1441	90-132 V ac 180-264 V ac
1461	90-136 V ac 180-272 V ac

1441 factory set at 115 Vac.
1461 factory set at 230 Vac.

Crest Factor	At least 1.35
Max Line Current	
1441	0.25 Amp
1461	0.3 Amp
Max Power Consumption	
1441	20 Watts
1461	40 Watts
Line Frequency	
1441	54-66 Hz
1461	48-66 Hz

PHYSICAL CHARACTERISTICS

Length	16.89 in (43.10 cm)
Height	1.72 in (4.37 cm)
Width	19.00 in (48.30 cm)

ORDERING INFORMATION

1441 VIR Signal Deleter/Inserter
1461 Insertion Test Signal Generator Deleter/Inserter

MAILMAN DATA ENTRY FORM

TELEVISION PRODUCTS

TEKTRONIX USE ONLY

Add ☐
Change ☐
Delete ☐
Record No. _____ (Change Delete Only)
Firm No. _____
TV Catalog ☐
F.O. No. _____
Territory No. _____

_____ Ext. _____ Date _____

_____

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Cdn. Prov. State Cdn. Zip Code

check the ***ONE*** cate-
ıat best describes
e of work you are doing:

Management
Purchasing
Research
Design/Development
Mfg./Production
Engr. Support
Standards/QC
Mktg./Sales
Consulting
Computer Programming
Info. Data Processing
Teaching/Instructional
Medical Diagnosis/
Treatment
Maintenance/Service
Numerical Analysis

3 Please check the ***ONE*** cate-
gory that best describes
what you consider yourself to be:

A ☐ Manager/Supvr.
B ☐ Buyer/Specifier
C ☐ Biologist
D ☐ Chemist
E ☐ Engineer
F ☐ Financial Analyst
G ☐ Geologist
H ☐ Instructor/Educator
I ☐ Medical Professional
J ☐ Mathematician
K ☐ Physicist
L ☐ Sales Representative
M ☐ Consumer EDP
N ☐ Scientific EDP
O ☐ Student
P ☐ Technician

4 Please check your product interests and indicate if you are a user of that product:

PRODUCT INTEREST
USER

A ☐ ☐ Automatic Correctors
B ☐ ☐ Waveform Monitors
C ☐ ☐ Vectorscopes
D ☐ ☐ Sync and Test Generators
E ☐ ☐ Picture Monitors

OTHER INTEREST

01 ☐ ☐ Oscilloscopes, Spectrum Analyzers, Non-video Signal Sources, Curve Tracers DVM's, Counters, and other test equipment produced by TEKTRONIX
06 ☐ ☐ Calculators, Programmable
04 ☐ ☐ Computer Terminals/Peripherals

technical aspects of: (Please check ***ONE*** item under the ***ONE***

ˆAL TELEVISION

Hospital
School
Patient Monitoring

5 SPECIAL SYSTEMS TELEVISION

A ☐ Hi Resolution
B ☐ Surveillance/Security
C ☐ Data Display
D ☐ Other (please describe)

_____

ˆ TELEVISION

We have origination
capability
Off-air only

6 OTHER TELEVISION ACTIVITY

A ☐ TV Systems Assembly
B ☐ TV Equipment R & D
C ☐ TV Equipment Marketing
D ☐ Other (please describe)

_____

☐ Recommend
☐ Specify/Evaluate

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3/76 C-177

C-176

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Name _____ Phone _____

Station or Company _____

Street _____ Zip _____

City _____ State _____ Zip _____

Street _____

City _____ State _____ Zip _____

☐ Please send me General Catalog
☐ Please call me about:
☐ Please send information on:

AUTOMATIC VIDEO CORRECTORS

The interface remains in the rack insuring program continuity when the Deleter/Inserter is removed (1441 Interfac

CHARACTERISTICS

Apply to both 1441 and 1461 unless otherwise stated.

PROGRAM PATH

Signal Input Level	1 Volt p-p Nominal
Program Gain	
1441	Unity within 0.5%
1461	Unity within 1%
Input Return Loss	
Power On	
1441	46 dB to 5 MHz
1461	At least 30 dB at 7 MHz
Power Off or Bypass	
1441	50 dB to 5 MHz
1461	At least 30 dB at 7 MHz
Input Impedance	75 Ω nominal
Output Return Loss	
1441	30 dB to 5 MHz
1461	At least 30 dB at 7 MHz
Output Impedance	75 Ω nominal
Output Blanking	
DC Level	0 V ± 50 mV
Amplitude Ratio	
2T Pulse to Bar	100% ± 0.25%
Mod Sin² Pulse	100% ± 0.50% (Chrom. to Lum.)
Waveform Tilt	
Line Tilt	
26 μs Bar (1441)	Less than 0.25%
25 μs Bar (1461)	Less than 0.50%
Field Rate Square Wave	Less than 0.50%
Differential Phase	
(10%-90% APL, Nominal Input)	0.15° or less (0.30° or less at + 3 dB for 1461)
Differential Gain	
(10%-90% APL, Nominal Input)	0.2% or less (0.4% or less at + 3 dB for 1461)
Line-time Nonlinearity	0.25% or less. (Unmodulated staircase)
Random Noise Output	At least 75 dB (RMS) down. (Weighted up to 5 MHz)
Non-Inserted Lines	
Residual Subcarrier	At least 60 dB down (1441, 3.58 MHz bandpass. 1461, 4.43 MHz bandpass.)
Hum or Transients	At least 60 dB down (Up to 5 MHz)
Spurious Signals	
1461	
During Blanking	At least 40 dB down (Up to 5 MHz)
During ITS and Active Picture Lines	At least 60 dB down (Up to 5 MHz)
1441	
Non-Inserted Lines	At least 40 dB down (Up to 5 MHz)
Signal Attenuation In Delete Mode	
2T Pulse	At least 70 dB (Up to 5 MHz)
Subcarrier (Color Bars)	At least 60 dB
Crosstalk Internal Signal to Program Channel	
2T Pulse	At least 70 dB down (Up to 5 MHz)
Subcarrier (Staircase)	At least 60 dB down up to 5 MHz
Time Jitter	5 ns or less
Video Delay	
1441	48° within 5° at subcarrier frequency
1461	60° ± 5° at color subcarrier frequency
Frequency Response	±1% to 6 MHz; + 1% to
1461	−6.5%, 6 MHz to 10 MHz
Unwanted Pedestal at Time of Test Signal Insertion	
1441	0.7 IRE or less
1461	5 mV or less
Subcarrier Lock (1461)	
Pull In	At least 150 mV p-p Burst
Hold In	At least 50 mV p-p Burst

1441 VERTICAL INTERVAL REFERENCE SIGNAL

VIR SIGNAL	
Chrominance	
Amplitude	40 IRE within 0.4 IRE
Phase	180° within 0.5°
Envelope Rise Time	1 μs
Phase Change with Burst Amplitude Change	1° or less (Burst amplitud varied from 40 IRE to 20 IRE or to 80 IRE)
Phase Change with Burst Frequency Change	1° or less (Burst frequency changed + 10 Hz or − 10 Hz from 3.579545 MHz)
Luminance	
Setup Level	7.5 IRE within 0.5 IRE
Gray Level	50 IRE within 0.5 IRE
Chroma Pedestal	70 IRE within 0.5 IRE

1461 INSERTED TEST SIGNALS

Inserted Signal Amplitude	±1% or nominal, 700 mV
Inserted Signal Blanking Adjustment Range	At least ±0.5 μs
Linearity Staircase Signal	
Luminance	
Amplitude	Within ±1% of Luminance bar amplitude
Line-time nonlinearity	The difference in amplitude between the largest and smallest risers is less than 0.5% of the largest amplitude
Rise Time	200 ns ±15% (2T filter)
Number of Risers	5
Chrominance	
Frequency	
Burst Absent	4.43361875 ±10 Hz
Burst Present	Frequency locked to burst
Amplitude	280 mV ± 1%

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I ☐ Medical Professional
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4 Please check your product interests and indicate if you are a user of that product:

	PRODUCT INTEREST	USER
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B	☐	☐ Waveform Monitors
C	☐	☐ Vectorscopes
D	☐	☐ Sync and Test Generators
E	☐	☐ Picture Monitors

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01 ☐ ☐ Oscilloscopes, Spectrum Analyzers, Non-video Signal Sources, Curve Tracers DVM's, Counters, and other test equipment produced by TEKTRONIX
06 ☐ ☐ Calculators, Programmable
04 ☐ ☐ Computer Terminals/Peripherals

5 I am primarily involved in the ***engineering*** and ***technical*** aspects of: (Please check ***ONE*** item under the ***ONE*** category that is most appropriate.)

1 INSTRUCTIONAL TELEVISION (Closed Circuit)
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B ☐ Academic
C ☐ Military/Governmental

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C ☐ Program Production Engineering

3 MEDICAL TELEVISION
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B ☐ School
C ☐ Patient Monitoring

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B ☐ Surveillance/Security
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D ☐ Other (please describe) _____

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C ☐ TV Equipment Marketing
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6 Please check your purchasing influence: A ☐ Purchase B ☐ Approve C ☐ Recommend D ☐ Specify/Evaluate

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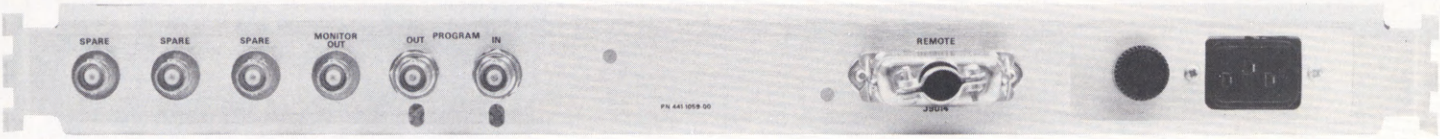
The 1478 manually corrects relative chrominance/luminance gain errors and can be used to calculate delay.



Positive Program Protection

Monitor Channel

Relative Chroma/Luminance Gain Correction

1478 CALIBRATED CHROMINANCE LEVEL CORRECTOR

The 1478 is an in-line manual chrominance corrector designed for use with NTSC, PAL, and PAL-M color video signals. Used with the 12.5 T or 20 T modulated sine-squared pulses, the 1478 is used to manually correct for relative chrominance/luminance gain errors which are usually caused by frequency response deficiencies in a video system.

Two signal channels are provided in the 1478, a program channel and a monitor channel. The monitor channel allows corrections to be previewed before committing them to the program channel. Any signal distortion measurements may also be carried out on the monitor channel. Front panel correction on/off switches have been provided for each channel.

Chrominance/Luminance gain errors are read directly from front panel controls. Delay errors may be measured with a waveform monitor or plotted on a nomograph.

The 1478 consists of two sections. One, the interface permanently mounted in the rack, contains inputs, outputs, and provisions for protecting program material. The second section contains circuitry and controls which are easily removed without cable disconnection or program interruption.

CHARACTERISTICS

Input Impedance—75 Ω.

Input Signal Level—1.0 V.

Thru Gain—1.0 ±0.5%.

Multiburst Flatness—±1% max.

Chrominance to Luminance Gain Ratio Range—3.58 MHz and 4.43 MHz 0.60 to 1.59 (in .01 steps).

Input to Output Phase Delay (at 3.58 MHz)—≈215° matched ±3° (operating and bypass).

Time Delay; Operating or Bypass—145 ns.

Output Impedance—75 Ω.

Return Loss

Input—46 dB to 5 MHz.

Output—34 dB to 5 MHz.

Bypass—40 dB to 5 MHz.

Chrominance to Luminance Relative Delay—5 ns or less.

With the Chroma Gain set at 1.0, the 2T Pulse-to-Bar Ratio is .99-1.01; 2T Pulse Overshoot and Preshoot is 1% or less; T Pulse-to-Bar Ratio at 100 ns HAD is .98-1.02 and at 125 ns HAD is .98-1.02; T Step Overshoot at 100 ns HAD is 3% and 125 ns HAD is 3%; T Step Preshoot at 100 ns HAD is 3% and 125 ns HAD is 3%.

Linear Distortions

Field Time Tilt—0.5%.

Line Time Tilt—0.5%.

Short Time Distortion (Ringing)—T Pulse 3%, 2T Pulse 1%.

Continuous Random Noise (Unweighted)—−66 dB to 5 MHz.

Non-Linear Distortions

Line Time Non-Linearity—0.5%.

Differential Gain—0.5%.

Differential Phase—0.5°.

Chrominance to Luminance Intermodulation—0.5%.

Dynamic Picture Gain—0.5%.

Dynamic Sync Gain—0.5%.

Phase Shift with Chrome Gain Shift—0° ±0.2°.

Power Requirements

Line Voltage—115 or 230 V ac ±10%.

Max Power Consumption—20 watts.

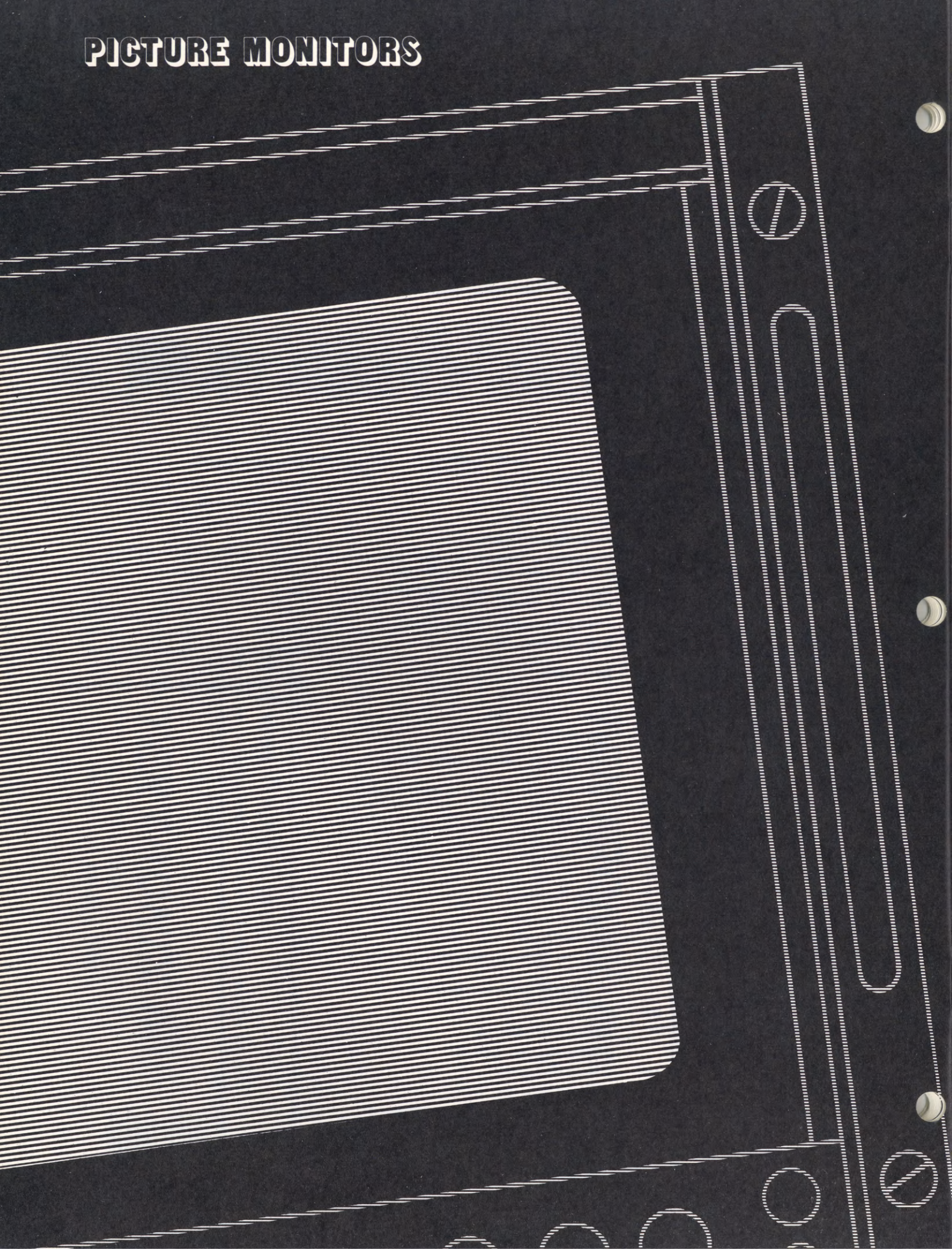
Factory set at 115 Vac.

DIMENSIONS AND WEIGHTS

Height	1.75 in	4.5 cm
Width	19.00 in	48.3 cm
Depth	16.89 in	43.0 cm
Net Weight	10 lbs	4.5 kg
Shipping Weight	17 lbs	7.7 kg

Order 1478 Calibrated Chrominance Level Corrector

PICTURE MONITORS



Picture monitors used in televison production and transmission facilities are required to present program material for critical evaluation by both engineering and production people. Therefore, consistent high-quality color reproduction is an important requirement, and TEKTRONIX Color Picture Monitors meet this requirement.

In addition to having stable, consistent color characteristics, TEKTRONIX Color Picture Monitors provide underscan and vertical and horizontal delay functions for detailed examination of the entire picture.

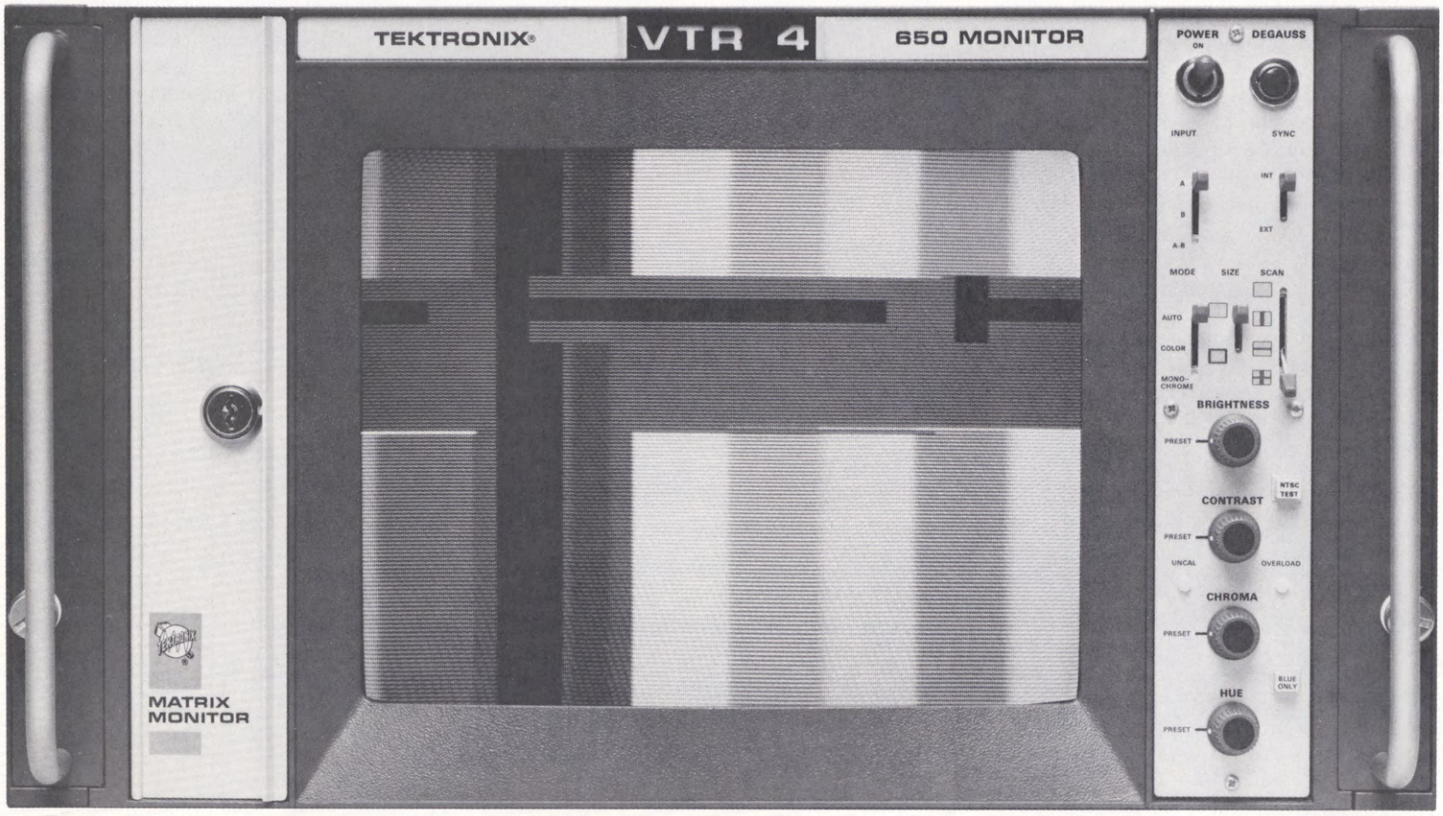
TEKTRONIX monitors are sized to fit the critical space requirements of your installations. The Trinitron kinescope makes both the 650 series and the 670 series simple to converge and contributes to the color stability of both series.

Monitor Series	Features	System	Type Number
650 Series 12 inch Trinitron 10.5 inch height Color Monitor	Preset operating controls to enable matching. Precise color tracking over brightness and contrast ranges. Black level set for linear kinescope operation. Such precise phasing (hue) that it can be used for adjusting system encoding quadrature. Expanded V in pulse cross and delay modes. Differential (A-B input) for sync timing, burst timing, and phase adjustments. Retrace so rapid that the entire active picture area can be displayed. Two switchable inputs isolated from ground for hum rejection. External sync switching capability. Optional multistandard and/or RGB capability. Such precise decoding that R-Y, B-Y outputs are optional for use in vector display on oscilloscopes.	NTSC NTSC plus RGB NTSC plus PAL NTSC plus PAL plus RGB PAL PAL plus RGB PAL-M PAL-M plus RGB	650 650-1 655 655-1 651 651-1 652 652-1
670 Series 17 inch Trinitron 15.7 inch height Color Monitor	Precise color tracking over brightness and contrast ranges. Black level set for linear kinescope operation. Such precise phasing (hue) that it can be used for adjusting system encoding quadrature. Expanded V in pulse cross and V delay modes. Retrace so rapid that the entire active picture area can be displayed. Two switchable inputs isolated from ground for hum rejection. External sync switching capability. Such precise decoding that R-Y, B-Y outputs are optional for use in vector display on oscilloscopes.	NTSC NTSC plus RGB PAL	670 670-1 671
632 Series 15 inch picture tube 10.5 inch height Monochrome	High Resolution Measurement Quality	525/60 and 625/50	632

PICTURE MONITORS

650, 670 SERIES

TEKTRONIX color picture monitors have the features and accuracy to reliably assess picture quality.



650 Series Monitors feature the 12 inch Trinitron. Any moire effects in this photo result from the half-tone process used in printing.

The TEKTRONIX 650-Series and 670-Series Color Picture Monitors have the features and accuracy to reliably assess picture quality. A specially-manufactured Sony Trinitron , with its simplicity of convergence and its adaptability to multi-standard usage, is the heart of each monitor. The construction of a monitor allows us to economically produce monitors for any standard used anywhere in the world. All TEKTRONIX Color Monitors maintain a uniform quality of performance previously unavailable.

The 650-Series Color Picture Monitors are particularly adaptable to precisely determining signal quality since they feature differential (A-B) inputs. Differential inputs are very useful in matching systems for cable length delays. The 670-Series Monitors have many of the features of the 650-Series and are excellent for applications requiring a larger picture.

In the details that follow, descriptions apply to both series. Exceptions unique to one of the two color monitor series are indicated.

PICTURE TUBE

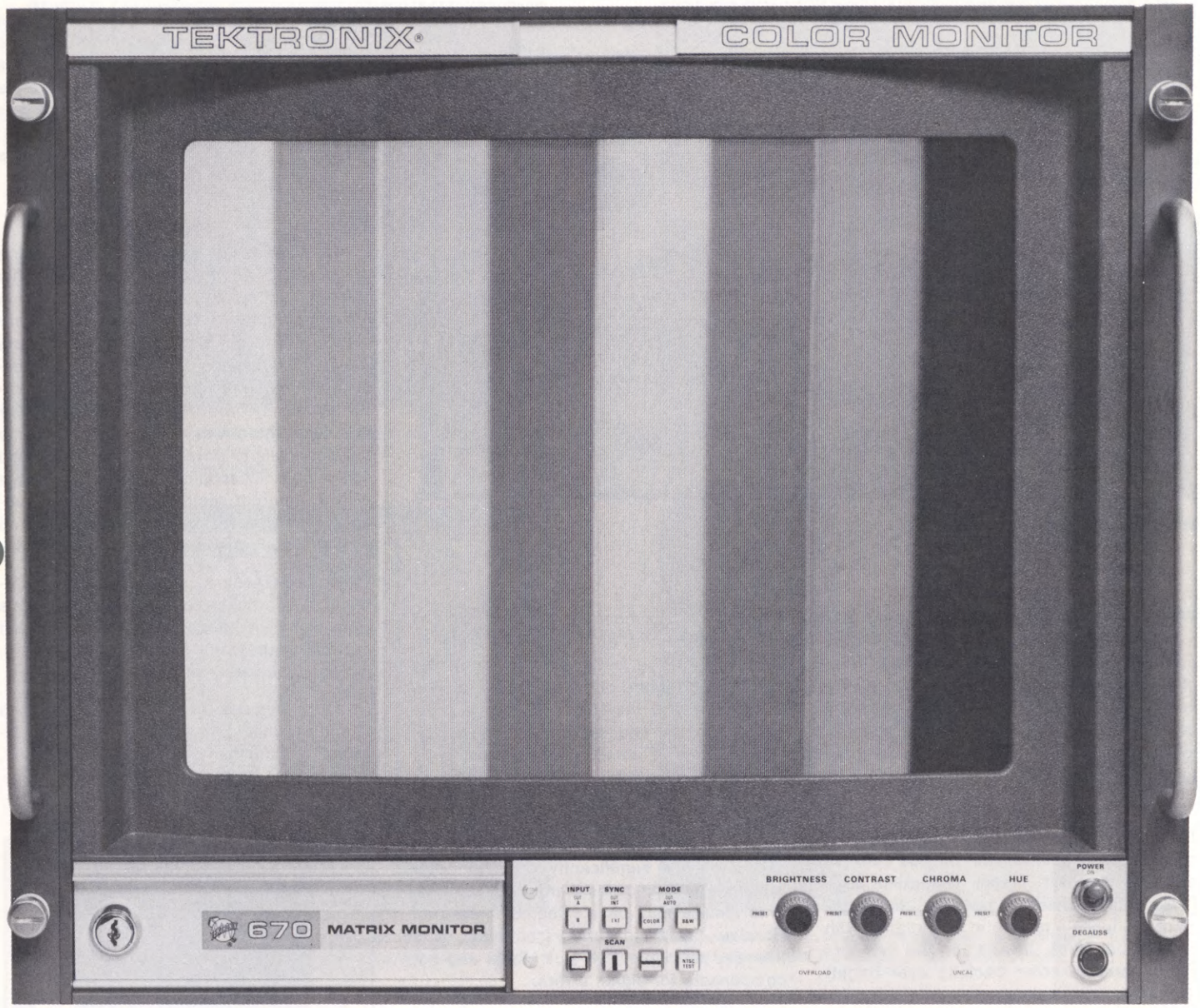
The Sony Corporation Trinitron kinescope has many advantages over currently available shadow-mask color picture tubes. Outstanding among them is the simplicity of its convergence adjustment. After the yoke has been positioned properly, convergence is adjusted by means of four front-panel controls located behind a lockable door. Not only are there far fewer controls, but their adjustment is straightforward.

Basic to the design of the Trinitron gun is the arrangement of the red and blue cathodes on the same (horizontal) plane as the green cathode which is located on the kinescope axis between the red and blue cathodes. Thus, convergence is primarily a matter of modulating the horizontal deflection component of the red and blue beams in opposite manner, but nearly equal amounts. The green beam, being on an axis, is not affected by convergence adjustments. Since the eye perceives green best, the green cathode is located in the center, which affords it the best focus of all three beams.

Moire patterns may be displayed on shadow-mask color picture tubes due to interference effects between the scanning line structure and the dot structure. This is minimized by careful design of the shadow mask for the line structure the tube is designed for; e.g., 625 lines or 525 lines.

The grille structure used in Sony Trinitron picture tubes is inherently free of this moire problem, hence the same Trinitron may be used on both 525 line and 625 line standards without compromise. This fundamental property of the Trinitron and the provisions for two decoders within the monitor make it universally usable on multiple standards.

The kinescope operates from a regulated EHT supply which is interlocked with the horizontal and vertical deflection circuits to avoid possible damage to the picture tube in the event of a deflection failure. During an EHT current overload condition, to avoid "blooming", certain characteristics of the monitor are altered; therefore, a front-panel OVERLOAD indicator is provided. An internal indicator of EHT failure is also provided.

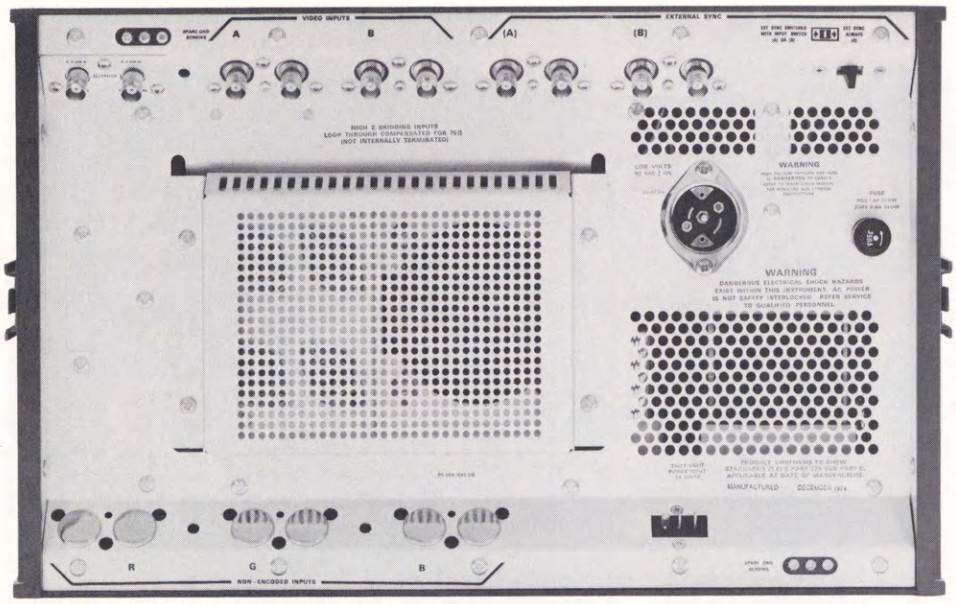


670 Series Monitors feature the 17 inch Trinitron. Any moire effects in this photo result from the half-tone process used in printing.

Reference white for the monitors is factory set to match illuminant D, whose color temperature is approximately 6500° K. Control range is adequate to permit readjustment to higher color temperatures where they are standard. The monitor is calibrated at the time of manufacture using a commercially available illuminant D white comparator. The screen color temperature is highly critical in accurate color reproduction and does vary with aging of the picture tube, regardless of design. Slight differences in color temperature between various monitors in a given broadcasting facility are far more serious than an absolute error in color temperature of all monitors at that facility. Thus, each facility will desire to maintain all monitors to match the reference white standard at the facility.

Two controls for each beam are provided to set up the color balance. The circuit arrangement permits one (bias) to set low level balance, the other (gain) to set high light color balance.

These controls have minimal interaction, speeding correct adjustment. By compressing the raster 10:1 vertically, a very accurate bias adjustment is rapidly established. The setup switch and all color balance controls are under the lockable door.



650 Rear Panel

TEKTRONIX Color Monitors now incorporate a correction matrix which allows viewing program material with essentially the same chrominance characteristics as a modern home receiver. The correction matrix may be switched out with a front-panel control to allow test and setup with classic demodulation characteristics.

PRESET CONTROLS

The chrominance gain and phase controls and the video gain and brightness controls are provided with preset calibrated positions. In these detented positions the instrument produces a picture in accordance with system standards. In addition the monitors exhibit precise color tracking over brightness and contrast ranges.

The color subcarrier is regenerated from burst with great accuracy, despite the many possible errors which may occur in burst itself with regard to timing, amplitude or transients (quadrature components). Burst itself is often regenerated in TV transmission; hence, this instrument should not exhibit any sensitivity to the peculiarities of the color burst component of the picture signal.

The phasing (Hue) of the 650, 670 Series is stable enough to confirm the phase accuracy of encoders, processing amplifiers, VTRs, etc. A "Blue Only" mode is used for this function.

Residual color subcarrier, present as a CW signal component of the encoded signal, causes a change in the colorimetry of the reproduced picture on home receivers. This occurs because the CW subcarrier is present on neutral shades of gray and white. Even subcarrier amplitudes too small to be easily noticed on the waveform monitor or vectorscope can change the observed color. Monitors are designed to detect residual subcarrier signal under these conditions and will display a significantly different color picture in certain cases than other monitors. This feature may be eliminated if desired. However, as a measuring instrument, it is intended to display the true signal and not compensate for signal errors.

When monitoring encoded signals, it is essential that the chrominance subcarrier does not reach the kinescope. If it does, the effects are: (1) Objectionable dot structure crawling vertically. (2) Gamma characteristics of the display will be altered by the chrominance subcarrier. The result is that highly saturated colors, especially in dark areas, will be substantially increased in brightness with a consequent decrease in saturation and contrast. A practical solution is to reduce the luminance amplifier frequency response in the vicinity of the color subcarrier. A luminance channel low-pass filter with *phase equalization* is provided to accomplish this objective.

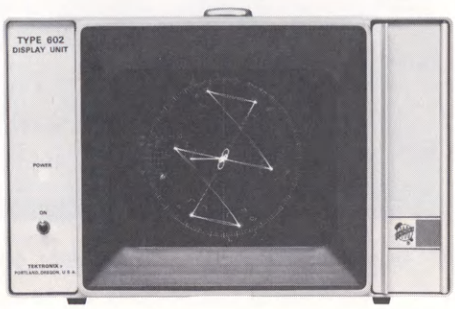
The MODE switch controls whether or not the chrominance channel is activated. In the AUTO mode, the chrominance channel is activated by the presence of burst. In the COLOR mode, the chrominance channel is activated whether burst is present or not; in MONOCHROME mode, the channel is deactivated despite the presence of burst.

VECTOR DISPLAY OPTION

The decoder design uses equiband decoding in the TEKTRONIX Monitors and is highly stable and accurate in phase and gain. Thus the color difference signals from the decoder may be used to provide a very accurate vectorscope display (comparable to the present state-of-the-art) on any suitable X-Y oscilloscope. By ordering Option 2, your color monitor is fitted with X and Y outputs at the correct levels to drive TEKTRONIX 602 and 604 X-Y Oscilloscopes. These are available with an internal vectorscope graticule suitable for both NTSC and PAL when ordered with Option 5. Also see VECTORSCOPES.

Those two-standard color monitors with Option 2 will provide color difference signals from whichever decoder is in use so that not only is the color monitor multistandard, but so is the vector display.

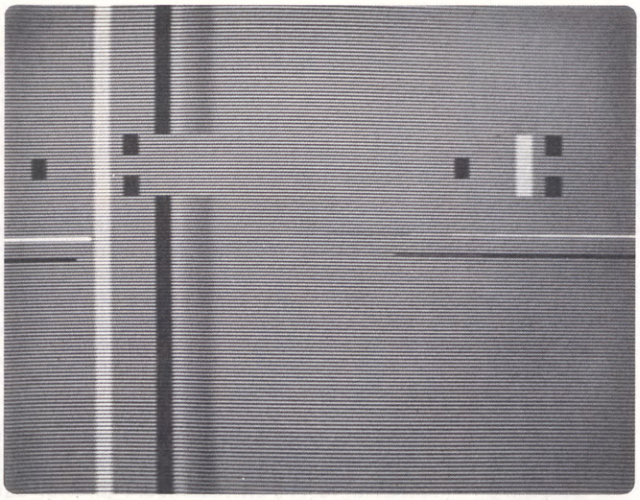
Option 2 provides a *vector only* display and is not well suited for transmission measurements of nonlinear distortions.



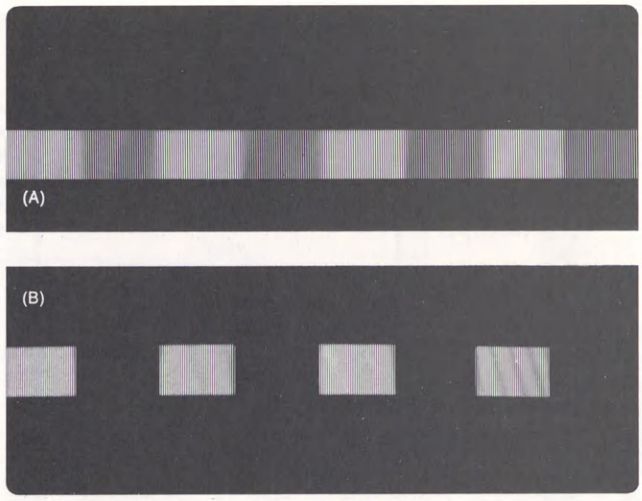
Precise decoding allows the 650, 670 Series Option 2 Monitors to be used with an X-Y oscilloscope for Vector displays. Shown is a TEKTRONIX 602 Option 5.

DISPLAYS

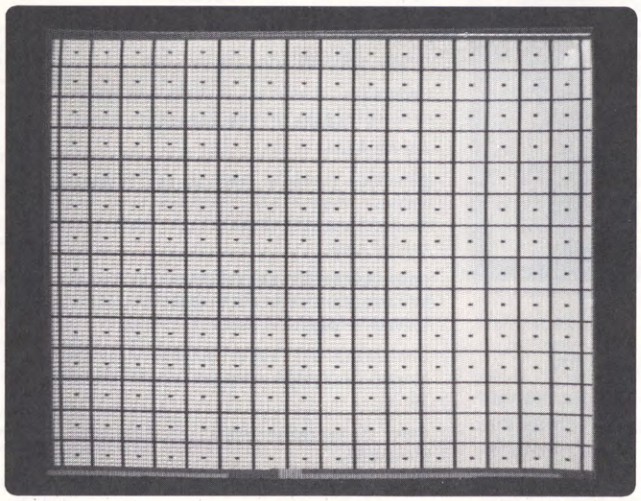
Two inputs are provided for encoded video signals. Each input can be isolated from the chassis to prevent ground current-induced hum. Each input is also isolated from all others. Hum is at least 50 dB down for mains hum up to 4 V RMS.



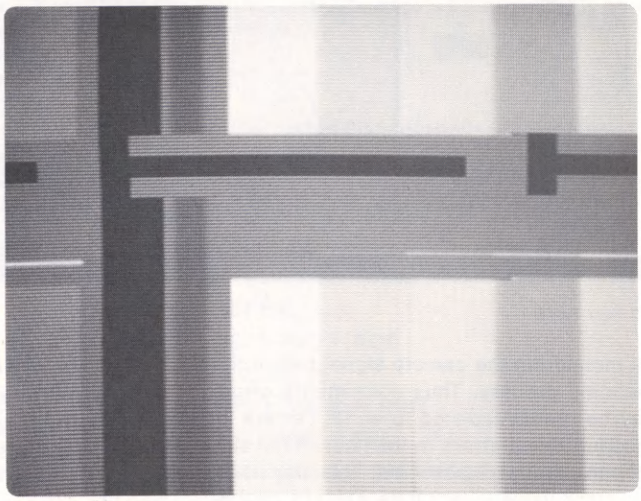
An A-B display of an expanded 650 Series pulse-cross display. Note the excellent cancellation of the two signals except for portions visible because of slight differences between cable length.



Bias adjustment for each beam is facilitated by a 10-to-1 raster compression. In this case blue bars are displayed (A) with bias adjusted for just-visible blue between the bars and (B) with bias setup for no visible blue between the bars. (650 Series Photo)



The entire frame area is visible in this underscan display. Exceptionally rapid retrace makes this display possible in the 650/670 Series. (Photo of 650 Series)



Here is the unique pulse-cross display that shows details of the vertical interval of expanding the V axis. (Photo of 650 Series)

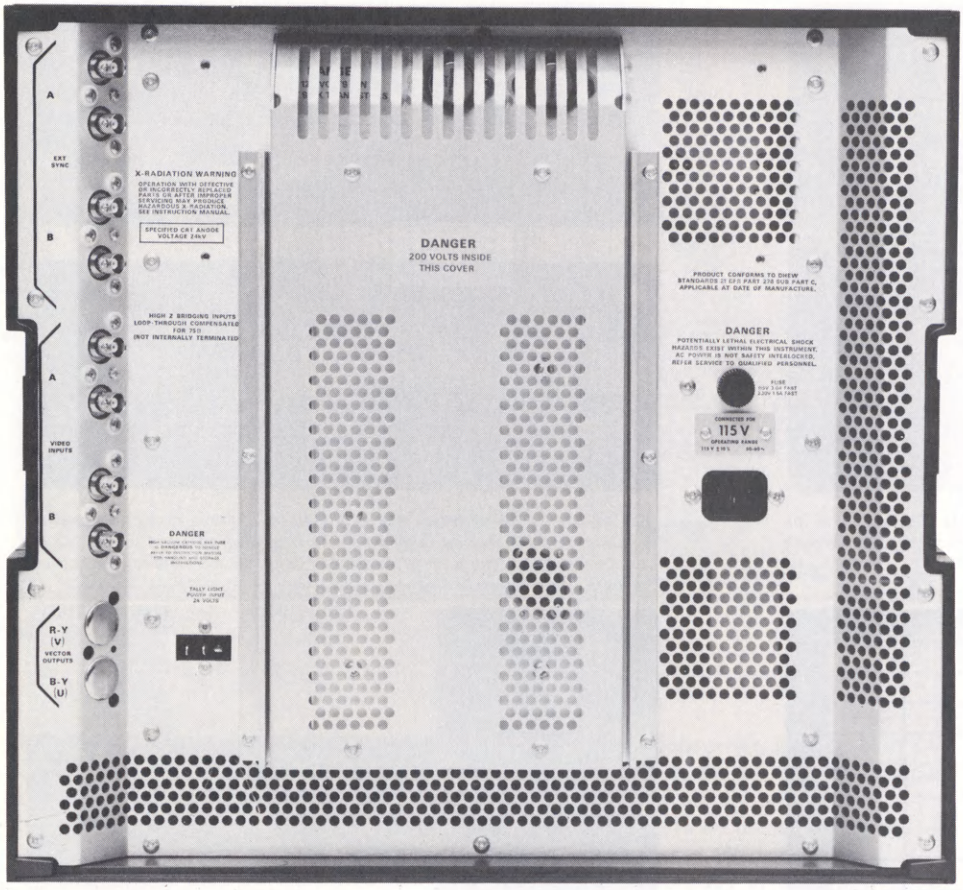
In the 650-Series the video inputs may be used differently (A-B) to display the difference between two video signals. While using the differential mode, the hum rejection feature is still available, even in the typical case of unequal hum levels. This is especially useful when timing two signal sources relative to each other. The pulse cross display may be used to observe sync blanking and burst. The differential input performance is excellent throughout the entire frequency band. Thus, it is also possible to accurately observe the relative phase and timing, e.g. breezeway the duration of two color bursts. This is a logical extension of the usual pulse cross capability of picture monitors.

In all TEKTRONIX Color Monitors the picture may be shifted either horizontally or vertically or both together (pulse cross). This permits monitoring sync, burst, blanking, vertical interval test and reference signals. When the monitor is operating in any of these display modes, brightness is automatically advanced to permit observation of the sync pulses and burst. Expansion of the vertical scan is provided in pulse cross and vertical delay modes to view individual lines in the vertical blanking interval.

Horizontal retrace is less than 10 microseconds. This is less than any horizontal blanking interval. The rapid retrace enables viewing (in reduced size mode) of the entire active video (picture) area. During this rapid retrace these monitors clamp video to the preadjusted black level. Time constants are chosen so that any hum component of the video signal will be displayed, alerting the video operator.

RGB VERSIONS FOR UNENCODED VIDEO AND INFORMATION DISPLAY

RGB Versions are designed for monitoring unencoded video signals. RGB inputs per-



670 Rear Panel

mit monitoring the camera signal before the encoding process. Thus colorimetric errors may be readily isolated to either camera or encoder. Small errors in the unencoded signal can readily be observed. This may be of particular value in accurate camera matching.

RGB versions are excellent for display of data from computers, process control systems, electron microscopes, and other systems requiring precise, multicolor displays. RGB inputs may be used to observe color television signals decoded from any standard. In these monitors, reliance can be placed upon their stable and accurate RGB tracking. A simple demonstration is highly convincing. The RGB inputs are normally isolated from each other and the chassis.

GENERAL INFORMATION

All signal connections to the picture monitor are made through BNC coaxial connectors located on the sloping rear panel of the instrument. Two connectors for each input provide compensated loop-through connections so that the instrument may be connected into any part of a system.

Two external composite sync inputs are provided with the capability of automatically switching between two external sync signal sources as the video input is switched, or for obtaining sync for both video inputs from one sync source as desired. The sync inputs are also isolated from each other and the chassis.

All components in the instrument are solid state except for the kinescope. All transistors and diodes are silicon devices. Most transistors and integrated circuits are socketed for ease in servicing. Semimodular construction is used with the glass-epoxy etched circuit boards readily removable for repair or replacement.

Remote Control—All instruments are capable of being modified for remote control. Certain circuits within the monitor, normally controlled by the right front-panel controls, can be remotely controlled through potentiometers, ground closures, or TTL circuitry. This requires special quotes.

Other Features—Manual degaussing facilities are provided. The 650 is available in either a 10½ inch rackmount form or cabinet form. A 24 volt tally lamp is provided with a set of characters for the tally window.

PICTURE

Height—650:7.23 in or 184 mm, 670:10.2 in or 259 mm.

Width—650:9.64 in or 214 mm, 670:13.6 in or 342 mm.

Underscan—Reduction in both height and width allows active area viewing.

Aspect Ratio—3:4.

Deflection Linearity (Vertical and Horizontal)—±1% within a central area bounded by a circle whose diameter equals picture height; ±2% outside of the central area.

Convergence Error—Less than 1 mm within the central area. Outside of the central area, color separation (misconvergence) is less than 2 mm.

Unblanking—All active picture elements are displayed (Horizontal retrace is accomplished within 10 μs).

Color Temperature—6500° K. Adjustable to other standards.

Calibrated Contrast—30 foot lamberts at peak white of standard 1 V signal.

Calibrated Brightness—Displayed black may be adjusted to black level of input signal.

E.H.T. (Extremely High Tension)—650 19 kV; 670 24 kV nominal, regulated. Load variations cause less than 1% picture height variation. Monitor conforms to Department of Health, Education, and Welfare regulation 42 CFR, Part 78, applicable at date instrument was manufactured.

Kinescope Protection— Failure of horizontal and vertical scanning shuts off the E.H.T. Failure of H.V. Regulator circuit does not cause E.H.T. to soar excessively. E.H.T. supply is current limited.

Heater Voltage—Regulated dc.

INPUT CHARACTERISTICS (All Systems, Sync, and RGB)

Connectors—BNC.

Signal Level—0.5 V p-p minimum composite video; 2 V p-p max.

IMPEDANCE

Unterminated—High Z bridging inputs loop-through compensated for 75 ohms (not internally terminated).

Return Loss—At least 46 dB to 5 MHz, power on or off, input in use or not.

Max Safe Input—Exceeds CCIR Recommendation 451-2 (±5 V peak).

Hum Rejection—Hum is at least 50 dB down when 5V max RMS mains hum signal is applied to the monitor in floating ground mode.

Differential A-B Mode Common Mode Rejection—46 dB, or greater, up to 4.43 MHz. (650 Series)

LUMINANCE CHANNEL (All Systems and RGB)

Dc Restoration—Back porch type; not affected by burst. Mains hum reduction due to dc restorer is less than 6 dB.

Amplitude Linearity—Within 2%.

Bandpass—Limited to approx 3 MHz.

NTSC CHROMINANCE CHANNEL

Demodulation Axis—R-Y, B-Y.

Bandpass—0.6 MHz equiband.

Gain Range—Preset at 0 dB; adjustable from −6 dB to +10 dB.

Residual Subcarrier Detection (on applied signal)—Color of displayed picture will shift to any residual subcarrier. This feature can be inhibited by a jumper on the decoder board.

PAL CHROMINANCE CHANNEL

Demodulation Axis—U, V.

Bandpass—Approx 1.2 MHz.

Gain Range—Preset at 0 dB; adjustable from −6 dB to +10 dB.

Residual Subcarrier Detection (on applied signal)—Color of displayed picture will shift due to any residual subcarrier. This feature can be inhibited by a jumper on the decoder board.

CHROMINANCE/LUMINANCE

Time Error—Less than 30 nanoseconds.

Gain Error—Less than 3%.

Delay—Red to green to blue in less than 30 nanoseconds.

SUBCARRIER REGENERATION

Phase Error—With 1° with input burst variation of ±10 Hz from 4.433619 MHz, nominal burst level.

With Temperature Variation—Within 5° with ambient temperature variation from 0°C to 50°C; within 1°, for any 10°C increment within the range 0°C to 50°C.

With Input Signal Variation—Within 1° with input signal variation of ±3 dB from 1.0 V. Within 3° with variation of burst/sync ratio of −6 dB to + 10 dB.

Breezeway Stability—0.2° or less for burst timing errors including burst width variance (8-11 cycles), and breezeway variance ±0.28 μs.

Phase Error Due to Noise—Within 1° with RMS white noise at −24 dB (0 dB + 700 mV RMS).

SYNC & TIMING

Signal Range—Composite sync 0.5 V p-p to 8 V p-p or composite video 0.5 V p-p to 2 V p-p.

Hum Rejection—Hum is at least 50 dB down when 5 V max RMS mains hum signal is applied to the monitor in floating ground mode.

Synchronization—Stable subcarrier regeneration, limited by line sync performance. Line sync white noise immunity is 20 dB. Field sync white noise immunity is 20 dB. Field sync stable with tilt equal to 100% of sync amplitude in vertical blanking. Stable with 20 IRE mains hum.

AFC—Two-loop AFC type.

Phase Corrector—Corrects for phase errors due to side pin cushion correction and other effects within the monitor.

Slow AFC—Displays timing errors of incoming sync; particularly, 60 Hz or 240 Hz timing errors. Bandwidth is approx 25 Hz.

Fast AFC—Largely corrects for incoming errors; approx 2 kHz bandwidth.

SCAN DELAY

Horizontal Delay—Approx ¼ line; displays burst.

Vertical Delay—Approx one-half field; vertical scan is expanded unless underscan is activated.

Pulse Cross—Displays horizontal and vertical blanking intervals; vertical blanking is expanded unless underscan is activated. All equalizing pulses are displayed.

POWER INPUT

LINE VOLTAGE RANGE

115 V—Within 10% (104 VAC to 126 VAC).

230 V—Within 10% (207 VAC to 253 VAC).

Crest Factor—At least 1.3.

Line Current—1.5 A RMS (650), 2 A RMS (670) max at 115 V, 60 Hz. 0.75 A (650), 1 A (670) max at 230 V, 50 Hz. Current is substantially higher during degaussing.

Degaussing Surge Current—5 A RMS.

Power Consumption—150 W Max, 110 W typical (650) 230 W Max, 110 W typical (670).

Line Frequency—48 Hz to 66 Hz.
650, 650-1, 652, 652-1, and 670, 670-1 are factory set for 115 V. 651, 651-1, 655, and 671 are factory set for 230 V.

DIMENSIONS AND WEIGHTS (650)

Cabinet Version—Width 16.75 in, 42.6 cm. Height 11 in, 28 cm. Length 16.5 in, 42 cm (includes mounting feet).

Rackmount Version—Width 19 in, 48.4 cm. Height 10.46 in, 26.7 cm. Length 18.25 in (includes handles), 46.5 cm. Weight 52 lb, 23.5 kg. Domestic shipping weight 67 lb, 30.4 kg. Export shipping weight 82 lb, 37.2 kg.

DIMENSIONS AND WEIGHTS (670)

Cabinet Version—Width 17.45 in, 45.2 cm. Height (includes mounting feet) 16 in, 40.6 cm. Length 19.5 in, 49.5 cm.

Rackmount Version—Width 19 in, 48.4 cm. Height 15.7 in, 40.1 cm. Length 21.25 in (includes handles), 54 cm. Weight 77 lb, 34.9 kg. Domestic shipping weight 92 lb, 41.7 kg. Export shipping weight 107 lb, 48.5 kg.

Included Accessories—7½ ft power cable, three wire (161-0036-00); indicator symbol film for tally indicator (334-1935-00); four cabinet feet and mounting screws (348-0080-01).

All 650 and 670 Monitors are shipped with rackmounting hardware. Cabinet version hardware is also included.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

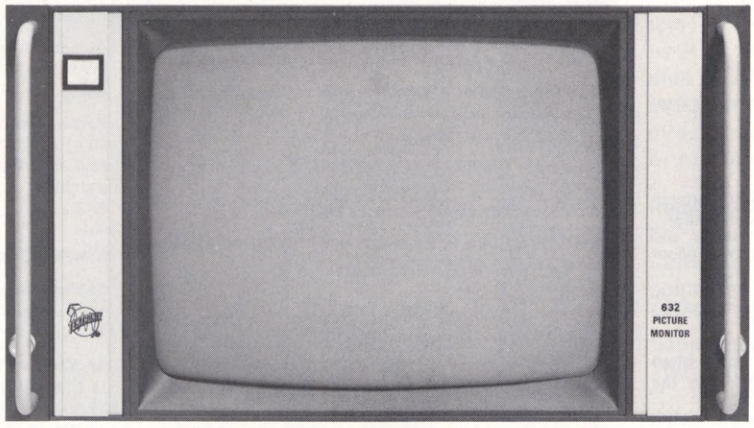
650 NTSC
650-1 NTSC + RGB
651 PAL
651-1 PAL + RGB
652 PAL M
652-1 PAL M + RGB
655 NTSC + PAL
655-1 NTSC + PAL + RGB
670 NTSC
670-1 NTSC + RGB
671 PAL

For Vector Display Options on 650 and 670 Series Monitors Order Option 2

602 Option 5 (X-Y Monitor)

604 Option 5 (X-Y Monitor)

This is a high resolution compact monochrome monitor.



AUTOMATIC SWITCHING BETWEEN STANDARDS 525/60 or 625/50

15 INCH DIAGONAL PICTURE TUBE IN 10½ INCH VERTICAL SPACE

HIGH RESOLUTION AT FULL DRIVE

NO BOUNCE WITH APL CHANGE

DIFFERENTIAL MODE A-B

CALIBRATED CONTRAST AND BRIGHTNESS CONTROLS

PULSE CROSS DISPLAY

VERTICAL BLANKING INTERVAL EXPANSION

TWO VIDEO INPUTS SUBCARRIER FILTER

The TEKTRONIX 632 Monochrome Picture Monitor is designed to display 50 fields/second 625 line or 60 fields/second 525 line television pictures. The switching between the 50 fields/second 625 line and 60 fields/second 525 line system is automatic.

The monitor is all solid-state (except kinescope) and requires only 10½ inches of rack space. The 632 can easily be changed into a rackmount version.

Independent vertical and horizontal delay are provided for adjusting video tape recorders and examination of the vertical and horizontal interval. Use of both vertical and horizontal delay provides an enhanced pulse cross mode. Additional display controls permit independent adjustment of vertical and horizontal size, and a push-button control is provided for an underscan mode (0.85 of full size).

The monitor has front-panel selection of two signal inputs, or the difference signal between the two channels.

The 632 maintains high resolution at full drive providing 650 lines at 50 footlamberts. Contrast (white level) and brightness (black level) can be either calibrated (for a 1.0 V p-p signal) or variable. The calibrated mode can be internally preset for a given video signal. The black level is stabilized (dc restoration) by a back porch sampling system, independent of varying video or sync amplitudes.

The monitor has either internal (displayed video) sync capability or external sync capability.

All inputs to the monitor are high impedance loop-through connected, compensated for optimum return loss when terminated into 75 ohms.

CHARACTERISTICS

DISPLAY

Normal Size— 8.8 in or 224 mm height; 11.7 in or 298 mm width.

Under Scan— (.85) 15% reduction of picture size.

Linearity, Vertical, and Horizontal — 2%.

Calibrated Contrast— 1 V for full contrast.

Variable Contrast— 0.25 V to 2.0 V video input for full contrast of the picture.

Brightness Calibrated—Contrast normal range is normal for 1 V video.

VIDEO INPUTS

Return Loss— 46 dB to 6 MHz with respect to 75 ohms.

Differential Input Mode A-B Rejection— 46 dB to 4.43 MHz with up to 2 V p-p input signal.

Video Performance Bandwidth—Up to 6 MHz, 50 V drive at crt cathode, —0.5 dB; 15 MHz 15 V p-p, —3 dB. Line time, field time distortion Nil.

Differential Gain Distortion— 2% or less at 45 V p-p crt drive.

Dynamic Gain Distortion—Less than 1%, 10-90% APL.

Dc Restoration—Keyed back porch clamp, no observable black level shift. 10-90% APL, burst present or absent. Crt heater voltage is regulated.

SYNC

External Input—Loop-through, floating ground. BNC connectors are standard.

Input Sensitivity— 1 to 8 V p-p composite sync (can internally be changed to positive going composite sync.)

Horizontal Pull-In Time—Fast or slow internally changeable.

OTHER CHARACTERISTICS

Input Voltages— 115, 220, 240 ±10%, 48 to 66 Hz.

Power— 80 watts max.

Dimensions

Cabinet Model (632)

Width: 16.8 in or 42.7 cm

Height: 11 in or 27.9 cm

Length: 16.9 in or 42.9 cm

Weight: 35 lb or 15.8 kg

Rackmount Model (R632)

Width: 19 in or 48.7 cm

Height: 10.5 in or 26.6 cm

Length: 18.5 in or 46.9 cm

Weight: 40.8 lb or 18.5 kg

Included Accessories—Power cord (161-0036-00); tally light connector plug (134-0132-00) and clamp (343-0309-00); indication symbols for tally light.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

Order 632, 15 inch picture monitor
Order R632, 15 inch picture monitor (Rackmount)


DISPLAY
EXT
5
10
C-VAR
TRIG PLRT
SLOW SWEEP
2
FIELD
LINE SELECTOR
14
15
16
17
18
19
20
21
12
13
11
VAR

WAVEFORM MONITORS

WHAT IS A WAVEFORM MONITOR?

The waveform monitor is a specialized oscilloscope with special triggering and vertical characteristics for accurate measurement of the composite video signal.

Waveform monitors easily trigger from composite video using field and line information. This allows display of all or selected parts of the full sequence of information in composite video. Ordinary oscilloscopes, no matter how versatile, do not have the trigger logic that permits this quick and absolutely certain selection of discrete segments of video.

Waveform monitors must display subtle errors which accumulate in complex systems to become visible errors to the tv viewer. Because you must see subtle errors, waveform monitor vertical amplifiers have very carefully controlled responses necessary for video system signal fidelity. Our waveform monitors also have special switchable filters to measure chroma (subcarrier), luminance with chroma eliminated, and full composite video with flat (within ±1%) response.

WHAT DOES A WAVEFORM MONITOR DO?

The waveform monitor performs two vital functions. (1) It is used to measure systems performance. (2) It is used to monitor picture signal.

Any video component of the composite video signal that can be displayed in a time reference can be defined in terms of amplitude, period and duration with a waveform monitor. Chroma, luminance, and sync are among the video components that are often measured.

Using specialized test signals (see *Generators),* waveform monitors can make differential gain measurements, Sin^2 Pulse and Bar tests, APL tests, and many other industry-defined tests.

Monitoring levels of program material in VTR's CCU's, transmission systems, and at other points is the other major function of waveform monitors.

WHICH WAVEFORM MONITOR?

Tektronix builds two groups of waveform monitors: the 1480 Series and the 528 with its options. Within each group there are monitors for 525/60 and 625/50 systems.

Check the chart for guidance—then review the specifications and ordering information on the following pages.

GROUP ONE

The 1480 Series allows higher resolution measurements, greater accuracy on amplitude measurements, brighter crt, and special operating modes.

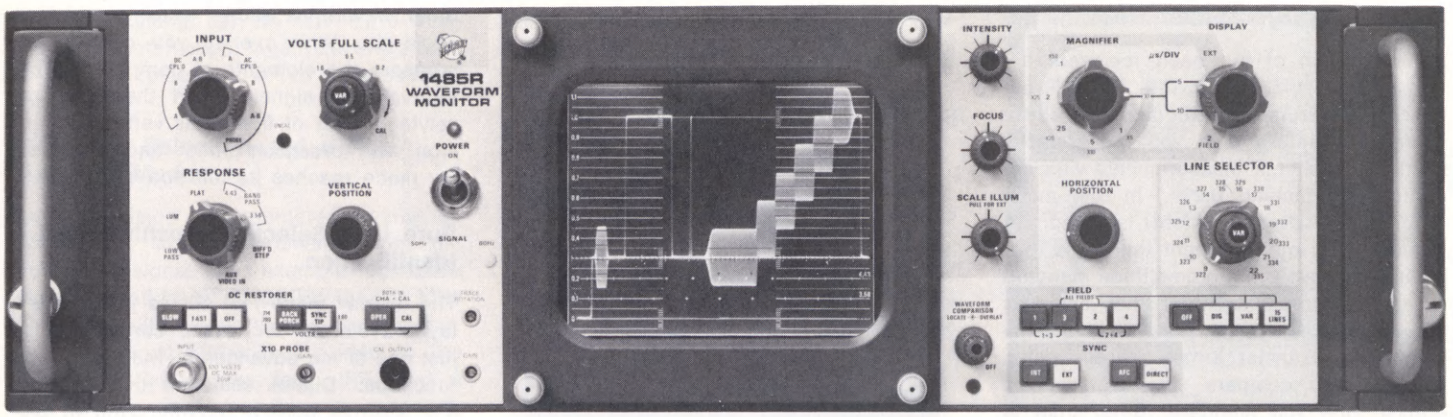
FEATURES	SYSTEM	INSTRUMENT
Precise Frequency Response, High Accuracy, Excellent Resolution, Bright Crt, Operating Modes.	**NTSC**	**1480C** **1480R**
Amplitude measurement accuracy approaching 0.2%.		
Precision display offset capability.	**PAL**	**1481C** **1481R**
A calibrated 5X expansion of vertical display.		
Fine crt spot size.		
New, bright crt especially suitable for vertical interval testing. 8 x 10 cm display area.	**PAL/NTSC Dual Standard**	**1485C** **1485R**
Overlay and sweep foldback modes.		
Digital selection of field and line.		
Line strobe output to drive vectorscopes.	**PAL-M**	**1482C** **1482R**
YRGB and RGB staircase inputs.		

GROUP TWO

The 528 and its options consist of compact units, especially well suited for use in camera control units, videotape recorders, closed circuit tv systems, and similar installations.

FEATURES	SYSTEM	INSTRUMENT
Precise Frequency Response, 5 inch crt, ½ rack size. Economical.	**NTSC and PAL-M**	**528**
8 x 10 cm display area.		
5¼ in vertical height and ½ rack width (for side-by-side mounting).		
YRGB and RGB staircase Inputs.	**PAL**	**528 Opt. 3**
Not suitable for most vertical interval testing applications.		

High measurement accuracy in many operation modes plus a choice of configurations and standards adapt this monitor to every monitoring application.



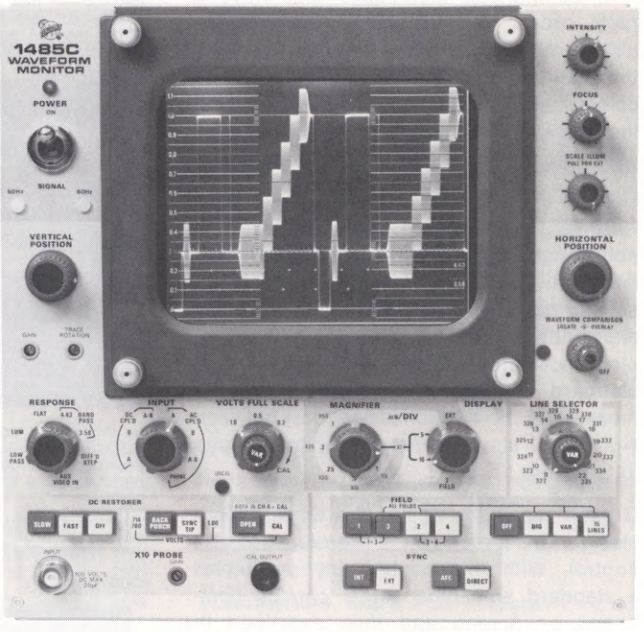
1480R PAL/NTSC Dual Standard Waveform Monitor. (Fits in standard 19 inch rack.)

See Any Vertical Interval Test Signal—Even with the Lights On (Brighter-than-ever crt.)

More Accuracy, Greater Resolution (Advanced measurement modes and calibrated 5X expansion of vertical display.)

Stable display in the Presence of Noise (Special sync separator circuit.)

Select One Line Out of Every Other Field (Digital selection.)



1485C Option 1 PAL/NTSC Dual Standard Waveform Monitor

Monitors for Every Broadcast Standard

The 1485C and 1485R PAL/PAL M, Dual Standard Monitors are shown because they represent the essentials of all eight monitors in the 1480 series. The differences between the monitors in the series are essentially confined to what lines in the vertical interval for examination selected and in the field selection modes. Dual-Standard Monitors recognize the signal standard in use automatically and indicate that standard with front panel indicators.

The 1480's have excellent amplitude measuring accuracy and many unique operating modes that enable you to work more precisely and accurately . But before going further let's get a question out of the way. Are the 1480's replacements for the 529? Yes. Where you used a 529 (or 527) one of the 1480 Series will slide in and you're ready to operate. But these new monitors are quite a bit more than just a replacement.

The monitoring needs of CCU, VTR, control room, transmission facilities, transmitter, and special systems have been researched thoroughly in order to assure that the 1480's will fit your expressed needs, and we believe that the 1480's have anticipated your needs for years to come. We will attempt to describe here the things that 1480's can do, but there is nothing like seeing one to really communicate the impressive performance of these monitors.

You Can See Any Vertical Interval Test Signal

Have you ever had to turn the lights down or shade a crt with your hand to see a particular Vertical Interval Test Signal? That is not necessary with the 1480 Series because the crt is bright. So bright that one Vertical Interval Test Signal selected out of four fields, can be seen with ease even in a well-lighted area. This solution to VITS display problems required the design of a new, and very high light-output, cathode-ray tube with fine spot size. But the bright crt is just one of the unique features of the 1480 Series.

More Accuracy, Greater Resolution

In recognition of the need for more accuracy the 1480's provide several advanced measurement modes. In these modes the 1480's give you the capacity to make amplitude measurements with accuracy approaching 0.2%. In one mode a precision display offset is used. A proven video measurement technique, offsetting displays with an amplitude standard is an easy-to-use method that achieves accuracy by eliminating parallax and transfer errors. Transfer errors are eliminated because you compare your signal to a precise one volt standard rather than to graticule calibration. Measurements made with comparison techniques also have a high order of consistency and repeatability. When your signal precisely matches the standard your signal amplitude will be determined to the value and accuracy of the offset. The tolerance of the internal calibration signal used as the standard is 0.2%.

Resolving power is an important factor in achieving very accurate amplitude measurements. The 1480's provide great resolving power through calibrated five-times expansion of the vertical display. Expansion not only means that signal and standard comparison is more precise, it means that the differences (errors) between signal and standard are easier to see and to measure.

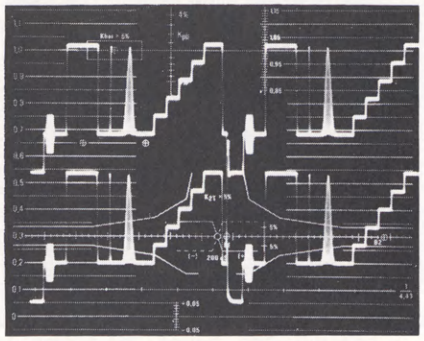
Greater resolution of the five times expansion is facilitated by a vernier position control. With this control any portion of a standard amplitude signal can be positioned on screen and then examined in detail. 0.2% amplitude standard, 5X expansion, offset comparison, fine crt spot size, these are some but not all, of the factors that make the 1480's very accurate video monitoring instruments.

A Mode for Side-By-Side Comparison

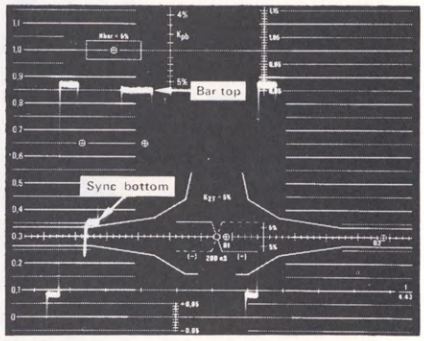
We call this mode overlay or sweep foldback. The 1480's can actually overlay a later segment of a display on the earlier segment. Superimposing waveforms over other waveforms allows exact comparison of levels. With overlay you can exactly compare the elements of complex vertical interval test signals. Add the extra resolving power of five times vertical expansion with precision offset and the overlay mode reaches its full potential.

DISPLAY OFFSET

. . . compare your signal to a precise one volt standard for accurate results.



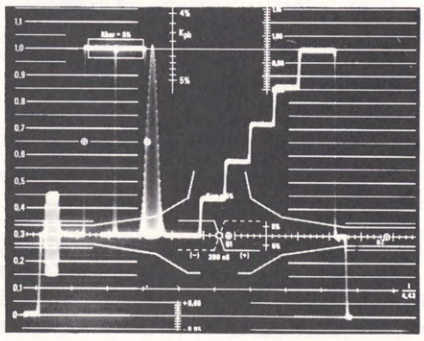
In this photo we reduced sensitivity below normal operating values to show how OFFSET places the top of one display on the same level as the bottom of another display of the same signal. Since the top and bottom line up the signal equals the offset standard.



In this photo scale factor is expanded 5 times to 0.2 volts full scale. Offset used with 5X expansion provides exceptional resolving power plus comparison accuracy. The signal shown is 10% high.

OVERLAY (SWEEP FOLDBACK)

. . . overlay signal elements for side-by-side comparison.



Pulse and Bar overlaid for precise comparison. Expansion can be used for more resolution. Offset and Overlay Techniques are fully detailed in TV Application Notes.

Sure Line Selection, Positive Field Identification

The overlay mode that allows you to overlay waveforms for exact comparison is just one of the advances in 1480 time-base functions. Digital selection of field and line assures positive identification of displayed information. For example when you select line 18 of field 2 it is certain that what you will see is line 18, field 2. Digital techniques will not allow an incorrect selection.

Variable selection of other lines is provided for full field signal analysis. The new 15-line mode is provided for working with quadruplex VTR's. In all line selection modes a line intensifying strobe is provided with video for picture monitor displays. A second line strobe output is provided to strobe 520-Series Vectorscopes, etc. Intensified two-field displays on the 1480 help you locate the line or lines selected.

15 Line Display for VTR's and Transmitter Applications

With the new 15-line mode the 1480's are particularly well suited to examine head by head performance of a quadruplex video-tape recorder. Without the conflicting pattern of signals from other heads, time base instability, jitter, distorted sync pulses, missing sync pulses, and field time distortions can be easily displayed. In addition the 1480 line strobe is very useful in selecting just the output from an individual head for measurement by a TEKTRONIX 520-Series Vectorscope. That makes it possible to measure chrominance phasing, differential phase and differential gain. In transmitter applications any field rate phase modulation that can cause hue shift, for example, right after

vertical blanking, can be seen on a TEKTRONIX Vectorscope. Again the line strobe is used to select the vector or vectors of interest.

Response Selection and a New Auxiliary Mode

Many television measurements require the filtering of some components from the composite signal. For example luminance signal rejection by 3.58 MHz or 4.43 MHz filters for differential gain measurements. A selection of filters is provided in the 1480's; including low pass, IRE, and a new one for staircase linearity measurements called differentiated staircase. There are five selectable filters. Your specialized or unique measurements may require a special filter. Insert that filter between the auxiliary video output and auxiliary input. This function allows you to add any filter or other device you choose without breaking into the program line. The auxiliary video input and output are buffered by amplifiers to provide a precise 75 Ω source and load. Another use of the auxiliary mode is to determine Chrominance-Luminance Gain and Delay inequalities with the TEKTRONIX 1478 Calibrated Chrominance Level Corrector. Again you can switch in this measurement any time without the inconvenience of disconnecting the program line.

Working Impedances Other Than 75 Ohms . . . A Probe Option (Option 1)

Did you ever want to use the special abilities of a waveform monitor in a high impedance circuit or where loop thru is inconvenient? The 1480's make convenient high impedance probing available with a Probe Option. This Option provides an input that accepts most Tektronix probes. As a part of this option a probe compensation waveform test point is provided. (A ten-times amplifier keeps full screen sensitivities at 1.0 V, 0.5 V, and 0.2 V while using X10 attenuator probes.) Without probe the ten-times amplifier can be used to achieve sensitivites as high as 20 millivolts full screen for special applications such as measuring noise and residual subcarrier.

Graticules, Focus and Intensity, and Factors Affecting Displays

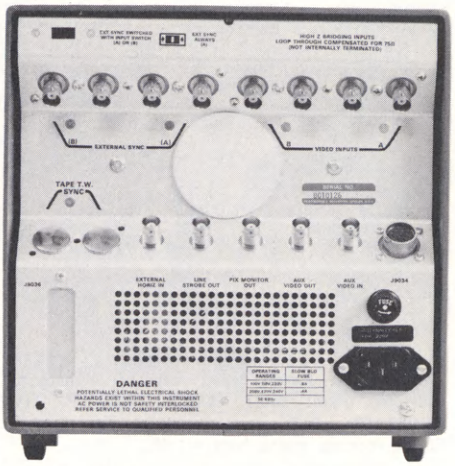
Exceptional brightness, greater accuracy . . what else is significant in the 1480's? Graticules, two of them are provided. One, internal and illuminated, is used for most of your applications. An internal graticule has no parallax. The other graticule is external and can be easily changed, a feature useful for special applications. The external graticule is illuminated by a separate system with a control that turns the internal one off—getting it out of sight so you can see only the external one. A selection of optional external graticules will be made available for 625/50 and 525/60 standards.

While we worked on factors affecting the display, we added focus and brightness controls that automatically compensate for changes in sweep rate. Switch from two field to a faster time base, intensity and focus are automatically reset to an optimum level. That makes this monitor even more convenient to use since crt controls do not need readjustment in normal operations.

A Fast Time Base with An AFC Mode

The sweep of 1480's is three times faster than the 529. 0.1 microseconds per division is the fastest sweep. Fast enough and bright enough (remember the bright crt) to examine T pulses even in the vertical interval.

The 1480's are calibrated in microseconds with a basic 1% time base accuracy. 2% when using the multiplier. 50X is the greatest range of magnification with steps of 10, 5, 2, and 1; calibration is in time and magnification value. The sync recognizer has a new automatic frequency control mode for the display of sync jitter which is caused by noise.



1485R rear panel.

Dc Restoration and Dc Coupling

Other improvements provided by the 1480's include slow dc Restoration which will display any hum present, or a new mode (fast) to filter out hum so that measurements can be made more accurately. Also selectable are backporch or sync tip dc Restoration. A dc coupled input mode is provided for measuring diode demodulator output and other applications.

CHARACTERISTICS

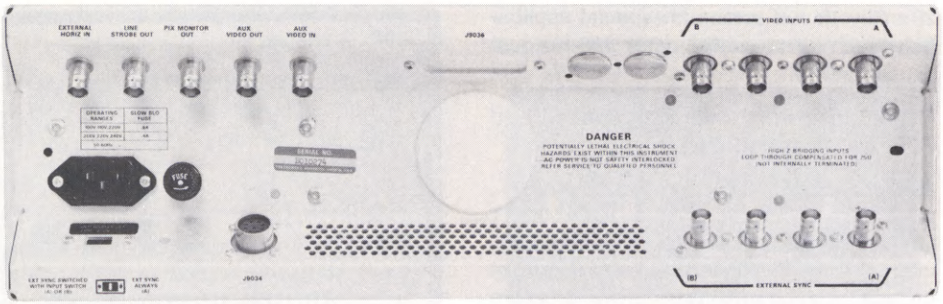
VERTICAL DEFLECTION

Inputs—Input A and B are 75 Ω high impedance loop-through. Return loss is ≥40 dB from dc to 5 MHz in a 75 Ω system. Aux Video Input is internally terminated in 75 Ω. Return loss is ≥34 dB from Dc to 5 MHz.

Scale Factor—A and B input calibrated— 1.0, 0.5, 0.2 volts full scale. Variable—range for each scale factor at least +40% to —50%. Aux Video Input 1.5 dB gain.

Max Input Voltage— 2 volts peak-to-peak (ac coupled).

Frequency Response—Flat—Flat to 5 MHz ±0.5%; 5 MHz to 10 MHz +0.5%, —5%*. Low Pass—Attenuation ≥14 dB, 500 kHz and above. 3.58 Band Pass—Amplitude within ±1% of amplitude in Flat response position. Bandpass approximately 600 kH. 4.43 Band Pass—Amplitude within ±1% of amplitude in Flat response position. Bandpass approximately 600 kHz. IRE—Conforms to IRE Standard 23S-1 1958 amended.



1485C Rear Panel.

DC Restorer—Keyed type, may be turned off. Clamping point: BACK PORCH/SYNC TIP. TIME CONSTANT: FAST reduces mains hum ≥26 dB, SLOW reduces mains hum <1 dB.

Calibrator—Amplitude selected by dc Restorer switch. Sync Tip — 1 volt ±0.2%, Back Porch — 714 mV or 700 mV ±0.5%.

Linear Waveform Distortion—Pulse/bar ratio ±1%. SHORT TIME: preshoot, overshoot, ringing ≤0.5% on 100 ns sin² pulse. LINE TIME: TILT or rounding ≤0.5%. FIELD TIME: (AC coupled) ≤1%.

Non-Linear Distortion—Differential gain ≤0.5%.

HORIZONTAL DEFLECTION

Time-Base— 5 μsec and 10 μsec/div, ±1% over center 10 divisions. 1μsec, 0.5 μsec, 0.25 μsec, 0.2 μsec and 0.1 μsec/div ±2% over center 10 divisions. 2 FIELD — 12.7 division ±1%.

External Sync Input—Two loop-through high impedance, with ≥46 dB return loss in a 75 Ω system. Inputs are slaved to A and B input or to A external sync input only.

External Sync Input Requirements— 400 mV to 2 volts composite video or 200 mV to 8 volts composite sync.

Field Selector—Positive selection of Field 1 or 2 in the NTSC system. Positive selection of 1, 2, 3, 4, or 1 & 2, 2 & 4 in the PAL systems.

Line Selector—Dig—Selects lines 9 to 22 NTSC, line 9/322 to line 22/335 PAL, line 9/272 to line 22/285 PAL-M. VAR—Approx line 20 of the selected field to line 8 of the next related field. 15 lines—Identical to VAR, except 15 successive lines are displayed.

Sync—AFC: Horizontal frequency range is 15.75 kHz ±200 Hz. Max. jitter with respect to input sync 10 ns (30 ns with 4 volts rms hum plus —36 dB white noise). Direct: Horizontal frequency ≤20 kHz. Max jitter with respect to input sync 12 ns (90 ns with 4 volts rms hum plus —36 dB white noise).

OUTPUTS

Line Strobe—TTL amplitude pulse. Pulse coincident with line or lines selected by VAR, 15 LINE or DIG modes of DISPLAY switch.

Picture Monitor—Output of incoming video with LINE STROBE added. Output impedance is 75 Ω. Output adjusted to unity with respect to A and B video input.

Aux Video—Output of incoming video. 75 Ω output impedance. Gain adjustable to unity with respect to A and B video input.

* Referenced to 50 kHz

OTHER CHARACTERISTICS

RGB/YRGB Staircase Input—Approx 12 volts for 12.7 divisions deflection. RGB sweep length internally selected for ⅓ normal sweep. YRGB sweep length internally selected for ¼ normal sweep length.

Mains Voltage—Ranges: 100 Vac, 110 Vac, 120 Vac, 200 Vac, 220 Vac, 240 Vac ±10%. Frequency: 48 Hz to 62 Hz, max power consumption 75 W. At factory, 1480 preset for 110 Vac. 1481, 1485 preset for 220 Vac. 1482 preset for 115 Vac.

OPTION 1

10X Probe Channel—Scale Factor 1 V, 0.5 V, 0.2 V full screen with 10X attenuator probe. GAIN range ±10%. Tile ≤5% on 50 Hz square wave, high frequency response ±1%, 25 Hz to 5 MHz. ±3%, 5 MHz to 10 MHz. Referenced to 50 kHz. Input resistance 1 MΩ, ±2%, not including probe. Input RC Product 20 μs, ±0.5%, not including probe. BNC connector accepts most TEKTRONIX probes. P6065A probe recommended.

10X Probe Calibrator — Output voltage 1.000 V ±0.005 V or 0.995 to 1.005 V.

	Cabinet		Rackmount	
Dimensions	**in**	**cm**	**in**	**cm**
Height	8.25	21.0	5.25	13.3
Width	8.50	21.6	19.0	48.2
Depth	16.95	43.0	18.0	45.7
Weight	**lb**	**kg**	**lb**	**kg**
Net	21.5	9.8	24.6	11.2
Shipping	≈28.5	≈12.9	≈53.1	≈24.1

Included Accessories— 351-0195-00 Slide, SWR, Ext Slide Pair (Rackmount Only).

GRATICULES See Page 92.

103-0031-00 (2 each) Adapter, Right Angle BNC.

ORDERING INFORMATION

1480C NTSC Waveform Monitor

1480R NTSC Waveform Monitor

1481C PAL Waveform Monitor

1481R PAL Waveform Monitor

1482C PAL-M Waveform Monitor

1482R PAL-M Waveform Monitor

1485C PAL/NTSC Dual Standard Waveform Monitor

1485R PAL/NTSC Dual Standard Waveform Monitor

Option 1 1 Megohm, 20 pf Probe Input (probe not included)
Suggested Probe
P6065A 10X Probe, 6-ft, Order 010-6065-13
9-ft, Order 010-6105-05

Option 2 With Carrying Case (Cabinet Version Only)

Option 3 With Blank CRT

Option 4 Tone Wheel Sync (1480C, 1481C, 1482C, and 1485C only. Replaces 529 or T04 in some RCA VTRs — Check with RCA for retrofit compatibility).

Option 5 Tone Wheel Sync (1485C only—check with RCA for retrofit compatibility).

OPTIONAL ACCESSORIES

Mounting Cradles—A cradle assembly, with associated bezel, allows the 1480C Waveform Monitor to be mounted alongside a 9 inch Conrac Picture Monitor in a standard 19 inch rack. A cradle and bezel are also available for mounting two 1480C's side-by-side.

For mounting 9 inch SNA-9 Picture Monitor (Requires 8¾ inches rack space)

Cradle Assembly **014-0020-00**

Bezel, for mounting 1480C on operator's left **014-0023-00**

Bezel, for mounting 1480C on operator's right **014-0024-00**

For mounting two 1480C Waveform Monitors side-by-side (requires 8¾ inches rack space)

Cradle Assembly **014-0020-00**

Bezel **014-0022-00**

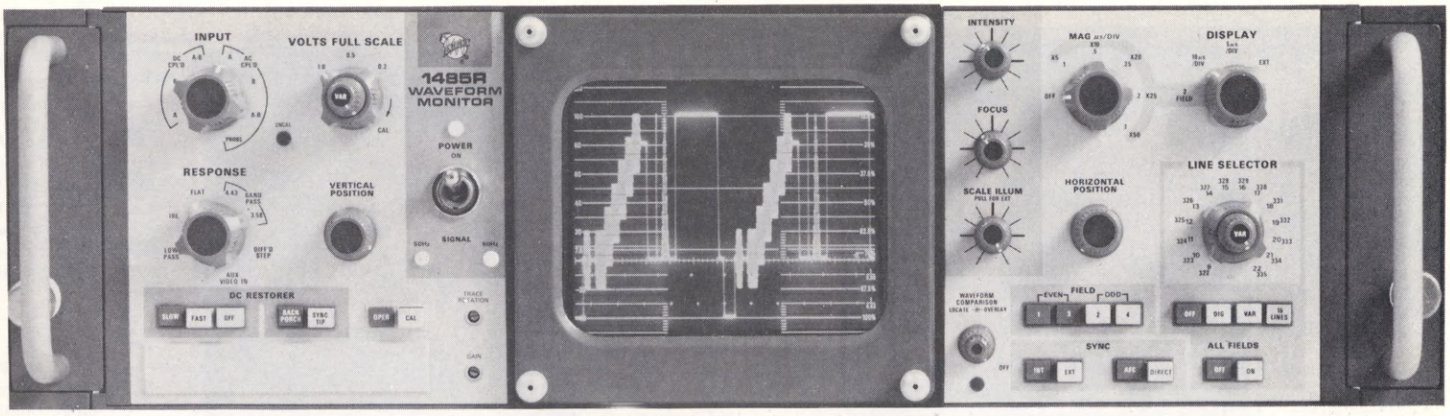
1480R Cradle Assembly—For mounting the 1480R in a WECO backless rack, **Order 426-0309-00**

For more information on cradle assemblies, see Accessories section.

C-59 recommended for display photos. See Camera section.

NEW 1480R Option 6

Especially designed for long-distance video transmission systems using 124-ohm balanced lines.



The 1480R Option 6 in its portable configuration. Internal Graticule A is illuminated.

Inputs Modified for 124 Ω Balanced Operation

5 to 12 Second Variable Sweep

Rackmount to Portable Conversion Kit

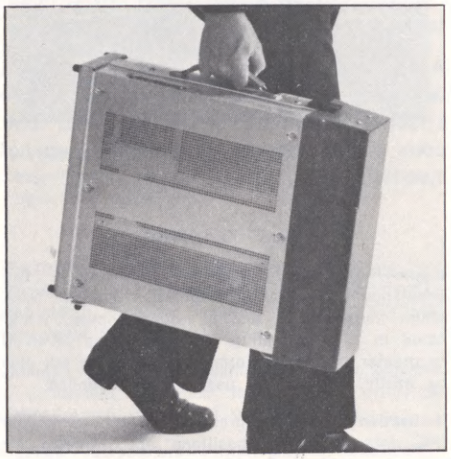
Differential Gain Position with X5 Gain

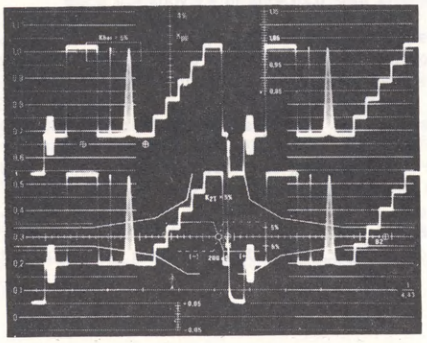
Special Transmission Measurement Graticule

The 1480R Option 6 is a high-performance television waveform monitor designed for use in your television operating center or by your field service force. Option 6 is especially designed for measurements in long-distance, video transmission systems using 124-OHM balanced lines. Self-normalizing WECO-style input jacks allow this instrument to operate in a 75 ohm system without externally terminating the ring input. With these features the 1480R Option 6 has been designed to operate in either a 124 ohm balanced or 75 ohm unbalanced system.

Vertical sensitivity, with automatic bandpass limiting, has been increased to 0.05 volts full scale for making differential phase and gain measurements with Bell Kelly or Telement Test Sets. <5 to >12 second, variable sweep has been added to measure low frequency distortions and system bounce caused by large APL changes in the video signal.

The new STOC transmission measurement graticule (Graticule A) has been incorporated in the 1480R Option 6. Insertion Gain, Line Time Distortion, Short Time Distortion, Chrominance to Luminance Gain Inequality are a few of the measurements made easier and more precise with this graticule. Television Application Note #20 describes the use of Graticule A.





Graticule B

MECHANICAL

If you require portability today and rackmounting tomorrow, the 1480R Option 6 is ideally suited to your needs. Each instrument is supplied with hardware for both rackmounting and portable configurations.

With the portable hardware installed, the instrument is comfortable to carry, much like an attache case. A protective cover will also protect your operating controls from accidental damage.

And, with additional input connectors on the front, and feet on the rear, the instrument can be operated face up behind those crowded delay racks. No need to worry about those bright lights when operating in this position. An extremely bright CRT makes this instrument well suited for operation under high ambient lighting conditions.

CHARACTERISTICS

The characteristics of the 1480R Option 6 are the same as the 1480R except as described on this page.

INCLUDED ACCESSORIES

Power cable, 3 wire, set of rackmounting hardware, Graticule Blank, Graticule B 100%, Graticule B photographic, protective cover assembly, foot assembly, handle assetmbly.

ORDERING INFORMATION

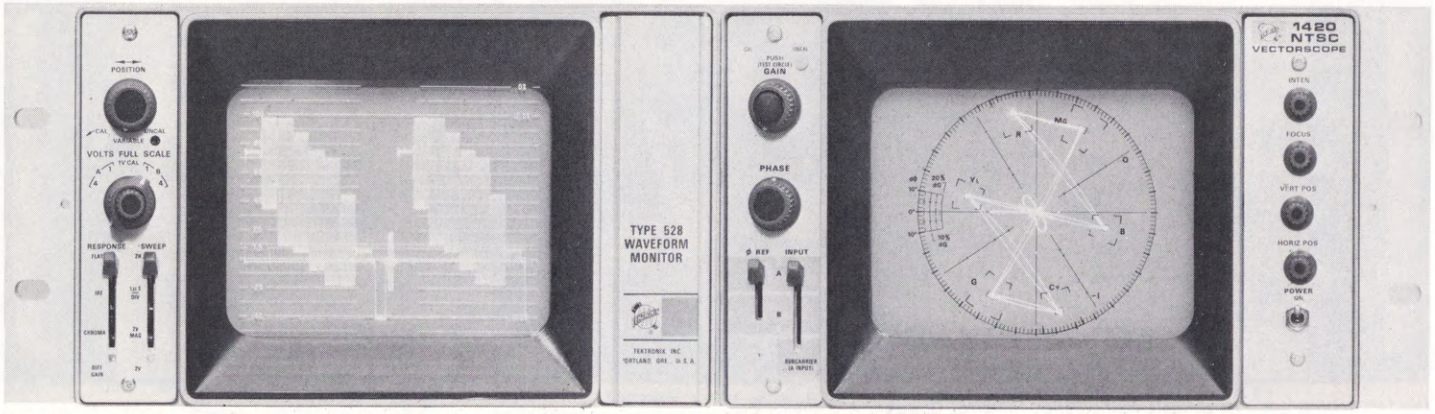
When ordering please use the exact nomenclature as given here.

1480R WAVEFORM MONITOR with OPTION 6

WAVEFORM MONITORS

528

A compact, half-rack width monitor for many applications.



528 Waveform Monitor mounted side-by-side with 1420 NTSC Vectorscope in optional rack adapter 016-0115-02.

Precise Frequency Response

5 in Crt

½ Rack Size

Economical

The 528 Waveform Monitor provides bright, easy-to-read video waveform displays on a 5 inch crt, yet requires only 5¼ inch vertical height and ½ rack width mounting space. This compact instrument is especially well suited for monitoring signals from camera outputs, video system output lines, transmitter video input lines, closed-circuit tv systems, and educational tv systems. A portable version is also available (see Option 2). Order Opt. 3 for 625 line systems.

Either of two video inputs, selectable from the front panel, may be displayed. The displayed video signal is also provided at a video output jack for viewing on a picture monitor. Calibrated, 1 volt and 4 volt full scale (140 IRE unit) sensitivities are provided for displaying common video and sync signal levels. A variable sensitivity control permits uncalibrated displays from 0.25 volt to 4.0 volts full scale. The built-in 1 volt calibration signal may be switched on to check vertical sensitivity calibration. Flat, IRE, Chroma, and Diff Gain frequency response positions permit observation of various signal characteristics.

Horizontal Sweep selection provides 2 H (two line), 1 μs/div (expanded two line), 2 V (two field), and 2 V MAG (expanded two field). Displays of RGB and YRGB waveforms from color camera processing amplifiers are provided for the interconnection through a rear panel 9 pin receptacle.

A dc Restorer maintains the back porch at an essentially constant level despite changes in signal amplitude, APL, and color burst. May be turned off when not needed.

VIDEO FEATURES

Inputs—Rear panel BNC connectors provide two unbalanced 75 Ω loop-through connections. Max return loss for A and B video inputs, terminated in 75 Ω, operating or nonoperating is 46 dB or greater to 5 MHz. Normally ac coupled but may be easily modified by user for dc coupling.

Deflection Factor—Calibrated 1 volt and 4 volt (140 IRE unit deflection) positions are provided for video inputs A or B with accuracy within 1% for the 1 volt positions and 3% for the 4 volt positions. A variable sensitivity control permits uncalibrated displays from 0.25 volts to 4.0 volts full scale.

Frequency Response—4 response positions are provided. FLAT—25 Hz to 3.6 MHz within 1% of response at 50 kHz, 3.6 MHz to 5 MHz +1%, −3% of response at 50 kHz. IRE—conforms to IEEE standard 205. Response at 4.43 MHz attenuated at least 22 dB. CHROMA—30% down between 3.1 MHz and 3.4 MHz, 30% down between 3.8 MHz and 4.1 MHz. Response at 3.58 MHz does not vary between FLAT and CHROMA by more than 1%. 528 Opt. 3 (625 line)—30% down between 3.83 MHz and 4.23 MHz, 30% down between 4.59 MHz and 5.07 MHz, response at 4.43 MHz does not vary between FLAT and CHROMA by more than 1%. DIFF GAIN—same as CHROMA response with additional gain for displaying 100 IRE units of 90 mV to 143 mV subcarrier levels.

Differential Gain—1% or less with 10 to 90% APL changes using DIFF GAIN operating mode with modulated staircase signal, base line adjusted to 50 IRE units position, and signal adjusted to 100 IRE units p-p.

Transient Response— 1 volt or 4 volt calibrated deflection factor, FLAT response position, using 125-ns HAD $\sin^2$ pulse and bar test signal: pre-shoot is not more than 1 IRE unit, overshoot not more than 2 IRE units, ringing not more than 2 IRE units, and pulse to bar ratio within 0.99:1 to 1.01:1.

Low Frequency Tilt—1% or less tilt on the vertical window or 60 Hz square wave (Dc Restorer off).

MAXIMUM INPUT LEVEL

Max Dc Input
5 volts‡ for all response positions using ac coupling.

Max Ac Input

FLAT and IRE Response—Signal levels should be limited to produce displays not exceeding 200 IRE units.

Chroma Response—Chroma levels up to 140 IRE units may be displayed, provided the chroma plus luminance level does not exceed 200 IRE units when viewed in the FLAT response mode.

Diff Gain—Subcarrier signal levels of 90 mV to 143 mV p-p may be expanded, using the variable gain control, to 100 IRE units for measurement of differential gain with 100 to 90% APL.

Dc Restorer—Slow acting back porch dc restoration. Blanking level shift due to presence or absence of burst or changes in APL from 10% to 90% will not exceed 2 IRE units. May be disabled.

Video Output—The displayed signal is provided at a rear panel BNC connector. Frequency response is 25 Hz to 5 MHz within 3%. Output signal amplitude is 1 volt within 15% for 140 IRE unit display using the FLAT response mode. Dc level is 2 volts‡ or less into 75 Ω load. Nominal output impedance is 75 Ω.

TIME BASE FEATURES

Synchronization—Internal or external sync is provided and is selectable by a switch behind the front panel door. Internal sync is derived from composite video input. External sync is via a rear panel BNC loop-through connector and requires 1.5 to 4.5 volts composite sync input. The unterminated sync input impedance is approx 15 kΩ paralleled by approx 5 pF and max input voltage is 20 volts.‡

Sweep Modes— 528 and 528 Opt 3. 4 sweep modes are provided: 2 V SWEEP—repetition rate equal to frame rate of applied video or external sync; 2 V MAG SWEEP—expands the vertical blanking interval (approx 20X magnification of 2 V); 2 H SWEEP—repetition rate equal to half-line rate of applied video or external sync; 1 μs/div SWEEP—calibrated sweep accuracy within 3% for center 10 div of 12 div sweep, and linearity within 3% throughout horizontal POSITION range, excludng first and last div.

‡Exceeds CCIR recommendation 451-2, paragraph 3.2.

YRGB AND RGB DISPLAYS

The 528 can be used with color camera processing amplifiers which provide the necessary sequential signal switching and staircase signals. A rear panel 9 pin receptacle provides the necessary interconnections. Factory wired for RGB (3 step) input.

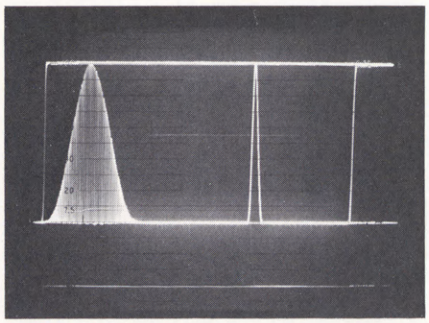
Staircase Amplitude—A 10 volt amplitude staircase signal will produce a 9 div display length within 15%.

Staircase DC Level—Peak ac plus ac signal levels shall not exceed limits of —12 to +12 volts. Max ac signal is 12 volts p-p.

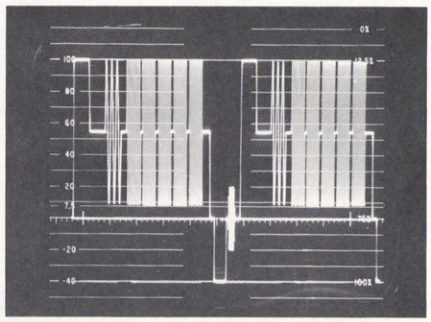
Control Signals—The RGB or YRGB modes may be initiated through the use of external voltage. (12 volts to 15 volts) or ground connection at the rear panel 9 pin receptacle. A 9 pin plug is supplied with the included standard accessories.

OTHER FEATURES

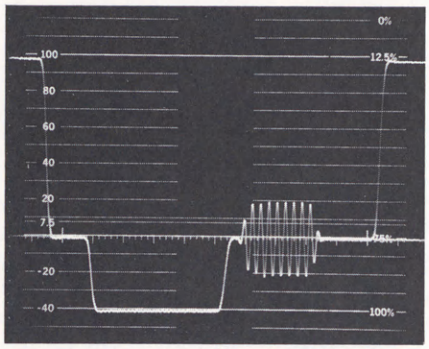
Regulated Power Supply—Operates on 99 volts ac to 132 volts ac and 198 volts ac to 264 volts ac, 48 Hz to 66 Hz line frequency. Operates on 115 volts ±10% or 230 volts ±10% at line frequencies from 55 Hz to 440 Hz. POWER CONSUMPTION: approx 48 watts at 115 volts ac, 60 Hz. 528 Factory set at 115 V, Option 3 set at 230 V.



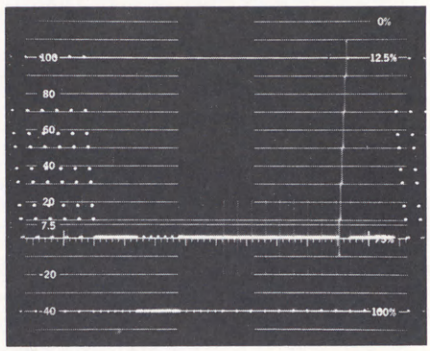
0.250 μs HAD Sin² Pulse (right) 12.5 T Modulated Sin² Pulse (left) 125 ns rise time bar (1T) also with bar superimposed.



Multiburst signal. 2-H Sweep, FLAT response.



Vertical Blanking Interval. 2-V MAG SWEEP. 20X magnification permits convenient vertical blanking interval observation.



Horizontal Blanking Interval, 1-μs/div calibrated sweep.

TEKTRONIX Cathode Ray Tube—Flat-faced 5 in rectangular crt providing an 8 x 10 cm display area. P31 phosphor supplied. External graticule with variable illumination.

Calibrator—An internal calibration signal provides a convenient reference for verifying deflection factor. Amplitude is 1.0 volt within 1%.

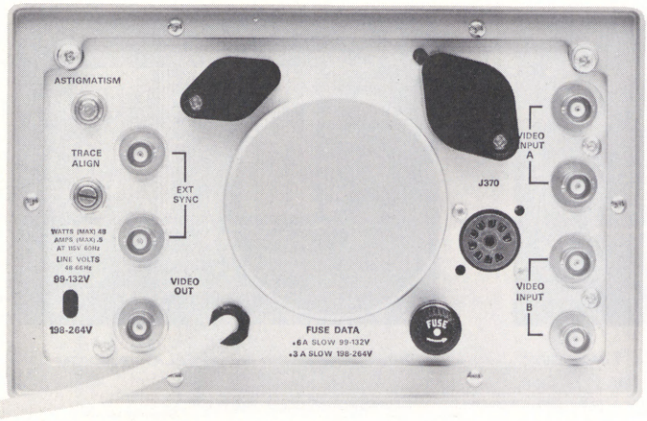
Ambient Temperature—Performance characteristics are valid over an ambient temperature range of 0°C to +50°C.

DIMENSIONS AND WEIGHTS

	in	cm
Height	5.25	13.3
Width	8.5	21.6
Depth	18.5	47.0
	lb	**kg**
Net Weight	15.0	6.8

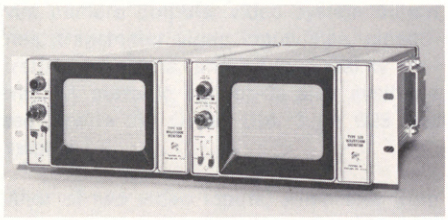
INCLUDED ACCESSORIES

9 pin connector (136-0099-00), connector cover (200-0249-00).



528 Back Panel.

Protective Carrying Case is included in Option 2.



Side-by-side mounting of 828's is provided by rack adapter 016-0115-02.

ORDERING INFORMATION

When ordering please use the exact nomenclature as given here.

528 Waveform Monitor (for 525 line)
Option 1 (as above less cover)
Option 2 (with blue protective cabinet)
Option 3 (for 625 line)

OPTIONAL ACCESSORIES

Mounting Cradles—A cradle assembly, with associated bezel and mounting brackets, allows the 528 Waveform Monitor to be mounted alongside a 9 inch Conrac Picture Monitor, in a standard 19 inch rack.

For Mounting 9 inch SNA-9 Picture Monitor (requires 8¾ inches rack space)

Cradle Assembly* **014-0020-00**

(Order 528 or 528 Option 3 for use in this cradle. The cover supplied with the instrument is required for cradle mounting).

Bezel and brackets for mounting 528 on operator's left **014-0038-00**

Bezel and brackets for mounting 528 on operator's right **014-0037-00**

Panel Assembly—For covering ½ of rack adapter when only one 528 is rackmounted, **order 016-0116-00.**

For more information on cradles, rack adapters, bezels, see Accessories section.

C-59 Camera recommended for display photos. See Camera section for information.

*Also order the appropriate bezel and brackets for mounting.

VECTORSCOPES

VECTORSCOPES

Tektronix, Inc. Builds three groups of vectorscopes. Within each group there are vectorscopes for NTSC, PAL or PAL-M measurements.

WHAT IS A VECTORSCOPE?

Vectorscopes are used to display and examine the chrominance signal.
Think of a vectorscope as an oscilloscope with a circular time base. It displays a polar plot with the radius a function of chrominance amplitude and the angle a function of chrominance phase. The chrominance phase is measured with respect to burst or a reference subcarrier.

Some vectorscopes offer linear time base displays in addition to vector displays.

WHAT CAN A VECTORSCOPE MEASURE?

Included in the wide variety of specialized measurements that TEKTRONIX Vectorscopes can measure are luminance amplitude, chrominance phase, chrominance amplitude, differential phase and differential gain.

Differential phase and differential gain are measurable directly. Use either a full-field test signal (as in out-of-service and proof-of-performance testing) or use a test signal in the vertical interval for in-service testing. The 520A, 521A, and 522A can select individual lines in the vertical interval.

Time delay between two signals can be checked by relating their phase differences at the subcarrier frequency. An example is the setup of two color cameras some distance apart. The two signals can be viewed together on a time-shared basis with the 520A, 521A, and 522A. Any time-delay difference between the two cameras will appear as a phase difference in the vector display. The connecting cable lengths can then be adjusted to minimize the difference so there will be no hue or phase difference between the two cameras.

WHICH VECTORSCOPE?

Tektronix builds **three groups** of vectorscopes. Within each group there are vectorscopes for NTSC, PAL, or PAL-M measurements. Some vectorscopes allow higher resolution measurements, dual vector displays, time base displays and other advantages.

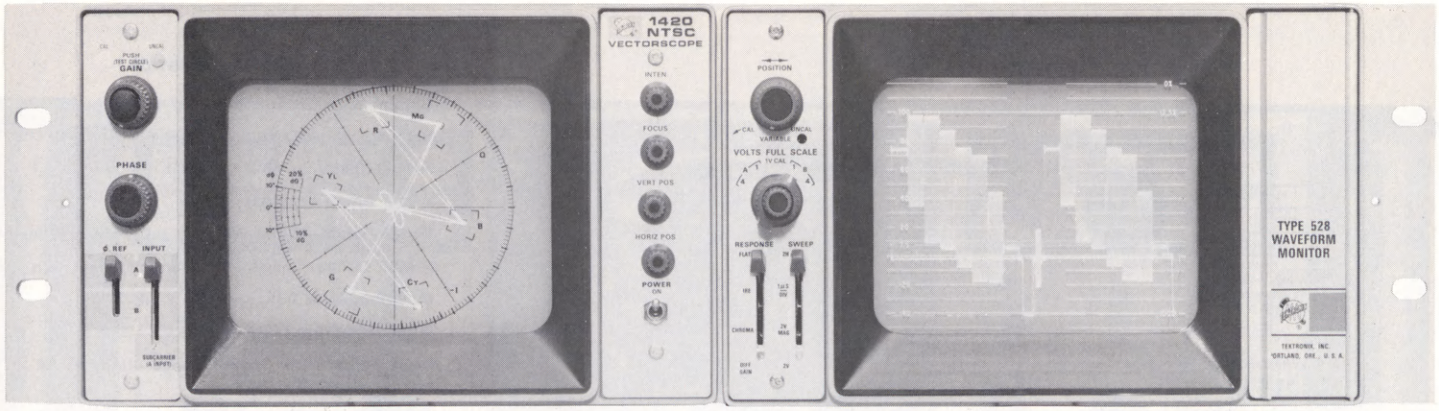
Some vectorscopes are available as rack-mount or cabinet models. Others will fit into optional rack adapters for side-by-side use. Some have carrying case options.

Check the chart for guidance—then review the specifications and order information on the following pages for detailed information about the model and options best for you.

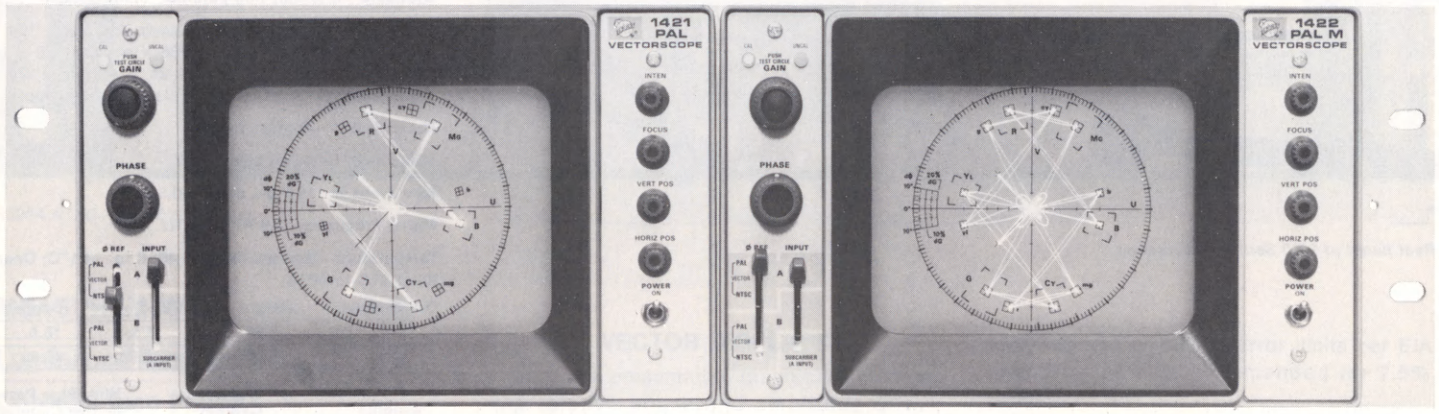
	FEATURES	SYSTEM	INSTRUMENT
GROUP ONE These compact units are especially well suited for camera control units, videotape recorders and similar installations.	**Single Display of Vectors for Moderate Resolution Measurements.** Vectorscopes are used to examine the chrominance components of the video signal. Where this examination just requires a single vector display and when your differential gain or differential phase measurements are to be made with moderate resolution, the 1420s are well worth consideration. The 1420s are half-rack size allowing for side by side installation with the 528 Waveform Monitor.	**NTSC** **PAL** **PAL-M**	**1420 Vectorscope** **1421 Vectorscope** **1422 Vectorscope**
GROUP TWO The Vector Display Option available with TEKTRONIX Color Picture Monitors.	**Single Display of Vectors (Driven from Color Picture Monitor 650 Series Option 2 or 670 Series Option 2) For Moderate Resolution Measurements. Requires R-Y and B-Y Inputs.** Simple vector display is available as an option with TEKTRONIX Color Picture Monitors. The vector option uses calibrated drive signals derived from the precision circuitry of the TEKTRONIX Color Picture Monitor to produce a vector display on a separate half-rack width monitor scope. Display phasing and amplitude are slaved to the hue and chroma controls of the picture monitor.	**NTSC** **PAL or PAL-M**	**602, Option 5 Oscilloscope** **or** **604, Option 5 Oscilloscope**
GROUP THREE The established standards of vectorscope performance and features.	**High Accuracy Measurements** **Dual Vector Displays** **Time Base Displays** **Vertical Interval Testing** In applications that require high-resolution measurements of differential phase and differential gain, or where dual vector displays or time base displays of luminance, red, green, and blue are needed, these Vectorscopes are recommended.	**NTSC** **PAL** **PAL-M**	**520A Vectorscope** **521A Vectorscope** **522A Vectorscope**

1420 NTSC
1421 PAL
1422 PAL-M

This series provides a low-cost way to meet basic vectorscope requirements.



1420 NTSC Vectorscope mounted side-by-side with 528 Waveform Monitor in optional Rack Adapter 016-0115-02.



1421 PAL Vectorscope and 1422 PAL-M Vectorscope in optional Rack Adapter. One display is in "NTSC FORMAT."

Lower Cost

Half-Rack Width

Two Loop-Through Inputs

Vector Display Only

Each 1420 Series Vectorscope is a compact, half rackwidth instrument designed to display vectors of the chrominance and burst components of the composite video signal. This series provides a low-cost way to meet basic vectorscope requirements in CCU's, VTR's, and similar applications. This instrument is particularly well suited for side-by-side rack mounting with the TEKTRONIX 528 Waveform Monitor. The Vectorscope weighs a little over 15 pounds with an optional carrying case.

The internal graticule is designed for the vector display of color bars and burst.

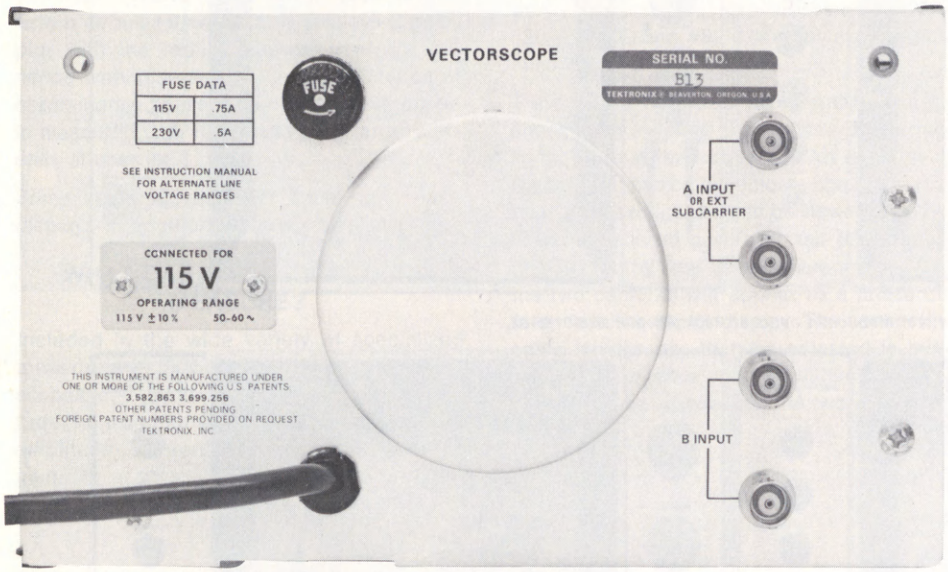
A special graticule feaure allows differential gain or phase errors to be determined to reasonable accuracy for many applications—within 2° and 5%.

Higher resolution differential gain and phase measurements should be made with a 520A Series Vectorscope.

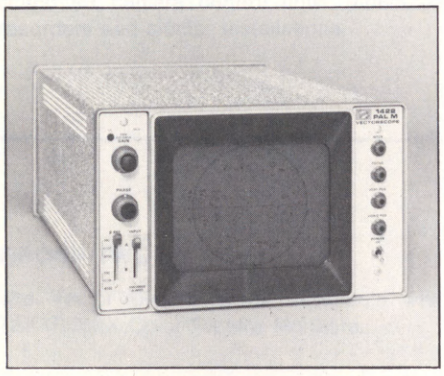
Two loop-through inputs accept the signal for display on the CRT or for externally locking the subcarrier regenerator oscillator. A front panel lever switch selects the signal from either of the inputs for phase locking the subcarrier regenerator.

A second front-panel lever switch selects the signal to be displayed on the CRT and can attenuate one channel to view large signals. A front panel gain control varies the size of the CRT display above and below unity. A phase control provides continuous 360° rotation of the display. PAL (1421) and PAL-M (1422) displays are switchable to an NTSC format.

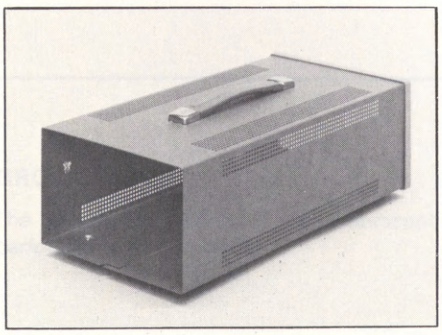
1420 NTSC
1421 PAL
1422 PAL-M



Rear panel of 1420 Series Vectorscope.



Metal cabinet shown is provided to protect the instrument unless Option 1 or Option 2 are ordered.



Option 2 includes a blue protective carrying case with handle.

CHARACTERISTICS

Chrominance Bandwidth—

Fsc +500 kHz ± 100 kHz (Upper −3 dB Point).

Fsc −500 kHz ± 100 kHz (Lower −3 db Point).

Vector Phase Accuracy—within 1°.

Pull-In Range—Within 50 Hz of subcarrier frequency.

PHASE Control Range—360° continuous rotation.

Input Amplitude Range—1 V ± 6 dB.

Input DC Voltage (Max)— +20 V, −20 V.

Front Panel GAIN Control Range—Unity to 5X unity and unity to 0.5X unity.

Input Return Loss—At least 46 dB to 5 MHz.

Graticule—Internal, non-parallax, unilluminated.

Mains Voltage Ranges—90 V ac to 110 V ac, 104 V ac to 126 V ac, 112 V ac to 136 V ac, and 180 V ac to 220 V ac, 208 V ac to 252 V ac, 224 V ac to 272 V ac, Ranges are selectable by internal plug-jumpers.

Crest Factor—At least 1.35.

Max Power Consumption—32 W.

Max Amps at 115 V ac, 60 Hz—0.5 A.

Mains Frequency—48 Hz to 66 Hz.

Temperature—Non-operating −40°C to +65°C; Operating 0°C to 50°C.

Dimensions	Height	Width	Depth
In	5.25	8.5	18.5
Cm	13.34	21.59	46.99

Weights	Without Cabinet	With Blue Protective Cabinet
Net	13.4 lb 6 kg	15.7 lb 7.1 kg
Shipping	20.0 lb 9.1 kg	

Included Accessories—Two 75-Ω Terminations 011-0102-00.

ORDERING INFORMATION

When ordering, please use the exact nomenclature as given here.

For NTSC, order **1420 Vectorscope** (Factory Wired for 115V)

For PAL, order **1421 Vectorscope** (Factory Wired for 230V)

For PAL-M, order **1422 Vectorscope** (Factory Wired for 115V)

OPTIONS AND ACCESSORIES

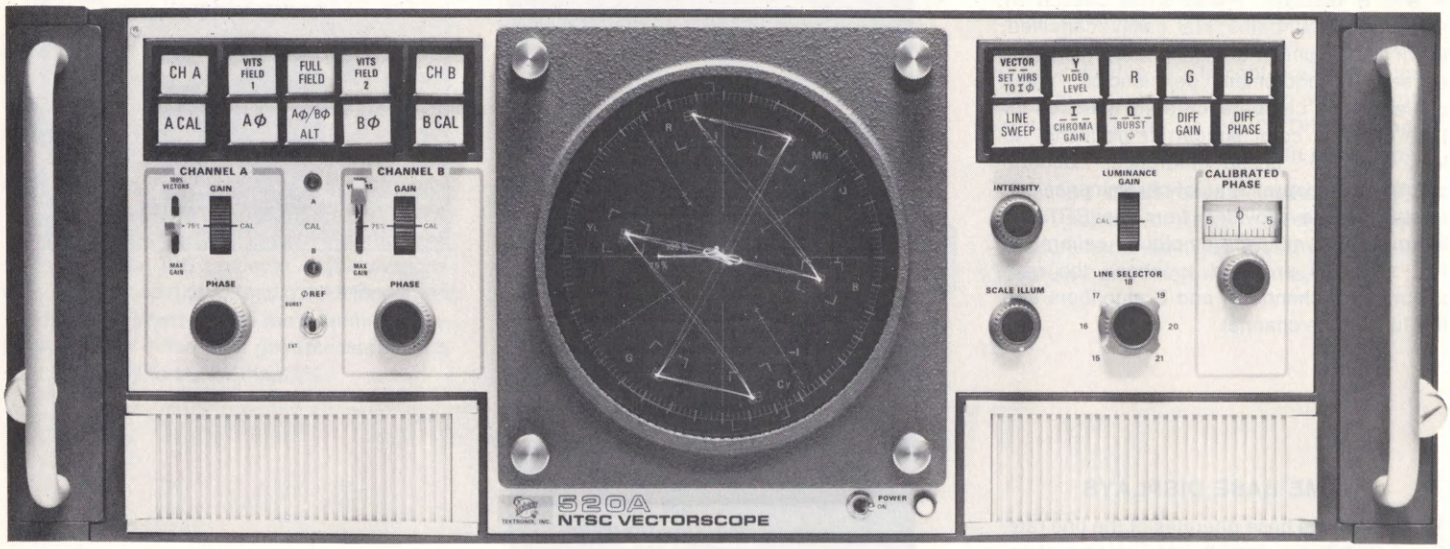
Rack Adapter, order **016-0115-02.** (When ordering the vectorscope for use in the adapter, order Option 1.)

Vectorscope without Cabinet . . . . . order **OPTION 1**

Vectorscope with Carrying Case . . . . . order **OPTION 2**

Recommended camera for display photographs: TEKTRONIX C-5A. See camera section of catalog for more information.

Consider this series for high resolution, dual-vector displays, vertical interval line selection, and time-base displays.



R520A NTSC (525/60 3.58 MHz).

MEASUREMENTS

Luminance Amplitude

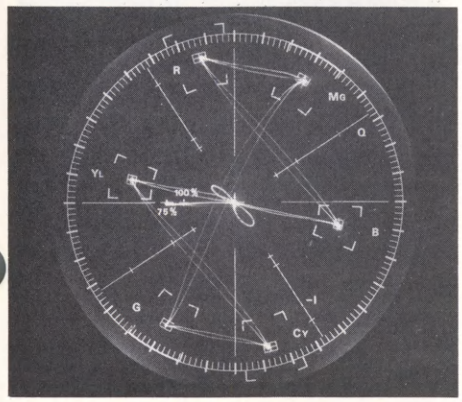
Chrominance Phase

Chrominance Amplitude

Differential Gain

Differential Phase

Figure 1. Vector display-full-field color bars, 75% amplitude, 100% white reference, 7.5% set-up. Conforms to EIA standard RS 189. 140 NTSC Test Signal Generator used as a signal source.



VECTOR DISPLAYS

The vector presentation graphically displays the relative phase and amplitude of the chrominance signal on polar coordinates. To identify these coordinates the graticule (see fig. 1) has points which correspond to the proper phase and amplitude of the primary and complementary colors: R (Red), B (Blue), G (Green), Cy (Cyan), Y_L (Yellow), and M_G (Magenta).

Any errors in the color encoding, video tape recording, or transmission processes which change these phase and/or amplitude relationships cause color errors in the television receiver picture. The polar coordinate type of display such as that obtained on the 520A CRT has proved to be the best method for portraying these errors.

The polar display permits measurement of hue in terms of relative phase of the chrominance signal with respect to the color burst. (Amplitude is expressed in terms of the displacement from center [radial length] toward the color point which corresponds to 75% [or 100%] amplitude of the particular color being measured.)

The outer boxes around the color points correspond to phase and amplitude error limits (± 10°, ± 20%). The inner boxes indicate ± 2.5° and 2.5 IRE units and correspond to phase and amplitude error limits per EIA specification RS-189, amended for 7.5% setup.

An internally generated test circle matched with the vector graticule verifies quadrature accuracy, horizontal to vertical gain balance and gain calibration for chrominance signal amplitude measurements. Two methods of measuring phase-shifts are provided. Large phase-shifts can be accurately read from the parallax-free vector graticule. A precision calibrated phase shifter with a range of 30°, spread over 30 inches of dial length, is provided for measuring small phase-shifts.

DUAL VECTOR DISPLAYS

In dual-channel operation, successive samples of channels A and B are displayed on a time-shared basis. The switching rate is locked to horizontal sync and switching transients are blanked. Input/output signals from video equipment can be conveniently compared on channel A or B for phase and/or amplitude distortion. The subcarrier processing channel contains two uncalibrated 0° to 360° phase-shifters and one 30° CALIBRATED PHASE shifter. While viewing channel A or B, either of the uncalibrated phase-shifters, AØ or BØ, can be switched into the subcarrier processing channel. AØ and BØ will lock to channel A and B respectively

when A and B channel are time-shared permitting independent phase control of channel A and B displays. Phase shifts caused by unequal signal paths are easily canceled, leaving only phase and amplitude distortion caused by equipment deficiencies. Video cable lengths can be accurately matched for time delay at color subcarrier frequency to less than 0.5° phase difference. Accurate amplitude measurements of chrominance and luminance are provided from the CRT. An internal 1-V luminance amplitude calibration test signal is provided to check the gain accuracy of channel A and B amplifiers and the luminance channel.

TIME BASE DISPLAYS

The linear time base operates at the line rate. Color signals are demodulated along any desired axis, I, Q, R-Y, B-Y, etc., and displayed at the line rate on a linear time base.

RED (R), GREEN (G), BLUE (B), and LUMINANCE (Y)

The 520A provides a luminance channel which permits the separation and display of the luminance (Y) component from the composite color signal (fig. 2). The Y component can also be combined with the output of the chrominance demodulators for R, G, and B displays at a line rate (fig. 3, 4, 5). Amplitude measurements of color signal components can be made with an accuracy of 3%.

VERTICAL INTERVAL TEST SIGNAL OBSERVATION

Vertical Interval Test Signals from front-panel selected lines of either field 1 or 2 can be displayed on the 520A Vectorscope.

Binary counters operate in conjunction with the field selector to select lines in either field that may carry suitable test signals. These circuits enable the Vectorscope to be used for measuring differential gain and differential phase from test signals transmitted in the vertical blanking interval.

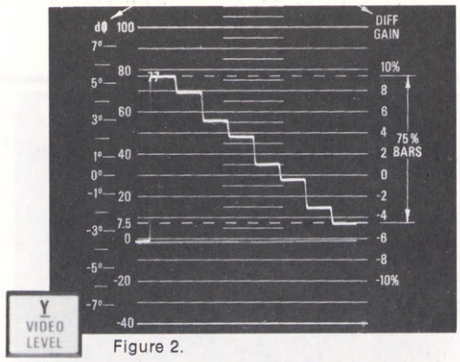


Figure 2.

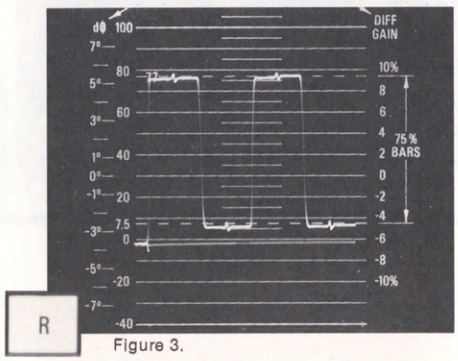


Figure 3.

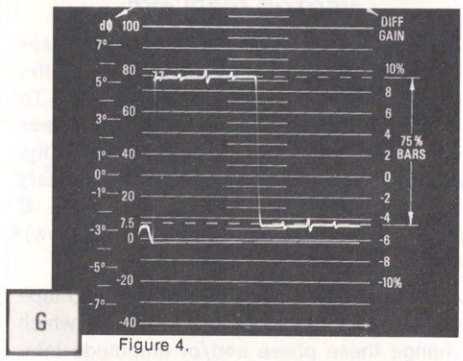


Figure 4.

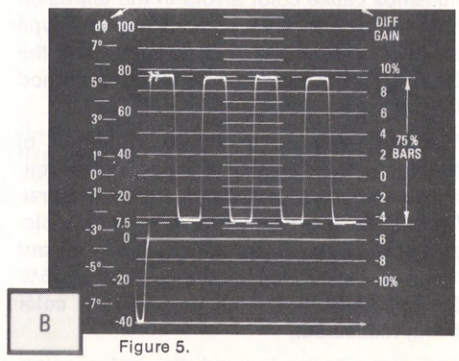
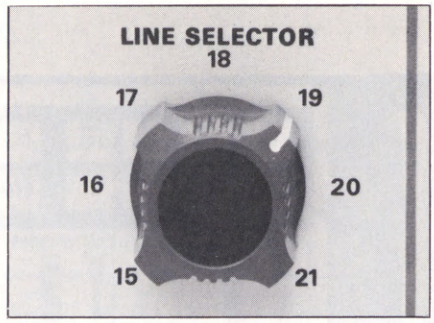


Figure 5.

75% amplitude EIA Color Bar Signal. Push-buttons select line-sweep displays of Luminance (fig 2), decoded Red (fig 3), decoded Green (fig 4), and decoded Blue (fig 5).



VITS Line Selector

DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE MEASUREMENTS

The two main chrominance-signal distortions are differential gain and differential phase. Both can be measured on the 520A Vectorscope. Differential gain (fig. 6) is a change in color subcarrier amplitude as a function of luminance. In the reproduced color picture, the saturation will be distorted in the areas between the light and dark portions of the scene. The IRE graticule major divisions represent percent of voltage gain or loss when making a differential gain measurement. The 520A permits differential gain measurements with accuracy to better than 1%.

Differential phase (fig. 7) is a phase modulation of the chrominance signal by the luminance signal. In the reproduced color picture, the hue will vary with scene brightness. Differential gain and differential phase may occur separately or together. Differential phase is read from the precision calibrated phase shift control or directly from the differential phase markings on the graticule. Dial resolution is within 1° represented by approximately 1 inch of dial movement. The vertical deflection of the display is greatly magnified and inverted on alternate lines allowing the use of a trace overlay technique and the slide-back method for measuring small phase changes. Using the CALIBRATED PHASE control, differential phase can be measured to 0.2°.

TWO METHODS OF MEASURING DIFFERENTIAL PHASE

Small differential phase distortions such as those found in studio systems, laboratories, or on individual equipment are most accurately measured by the two-trace overlay method as shown in fig. 7. This method is independent of differential gain distortion.

A second direct-reading method (fig. 8) is better suited for larger differential phase measurements such as found in video-tape recorders and microwave links.

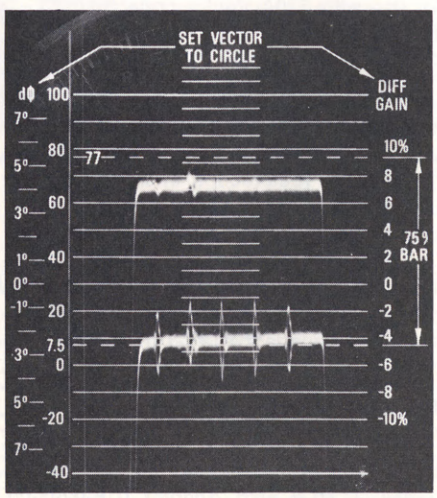


Figure 6. Differential Gain display from the 520A using the 140 NTSC Test Signal Generator. Lower trace, luminance is on. Upper trace, luminance is off. Minor divisions of graticule indicate 1% Differential Gain. Double exposure.

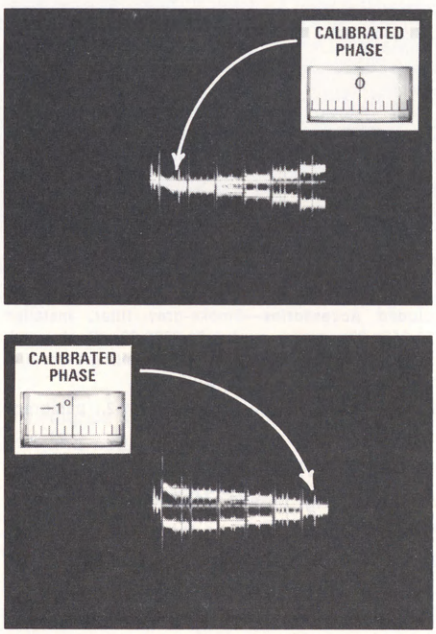


Figure 7. Differential Phase presentation using a modulated staircase signal. A trace overlay technique provides excellent resolution for measuring small phase changes. From reference point in top photo (1st step of staircase signal overlayed) to point of measure in bottom photo (6th step overlayed) represents 1.2° differential phase distortion.

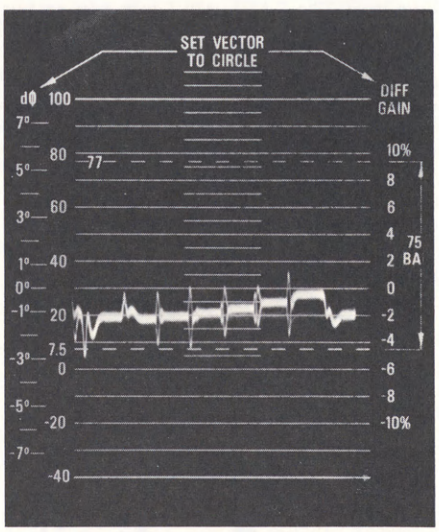
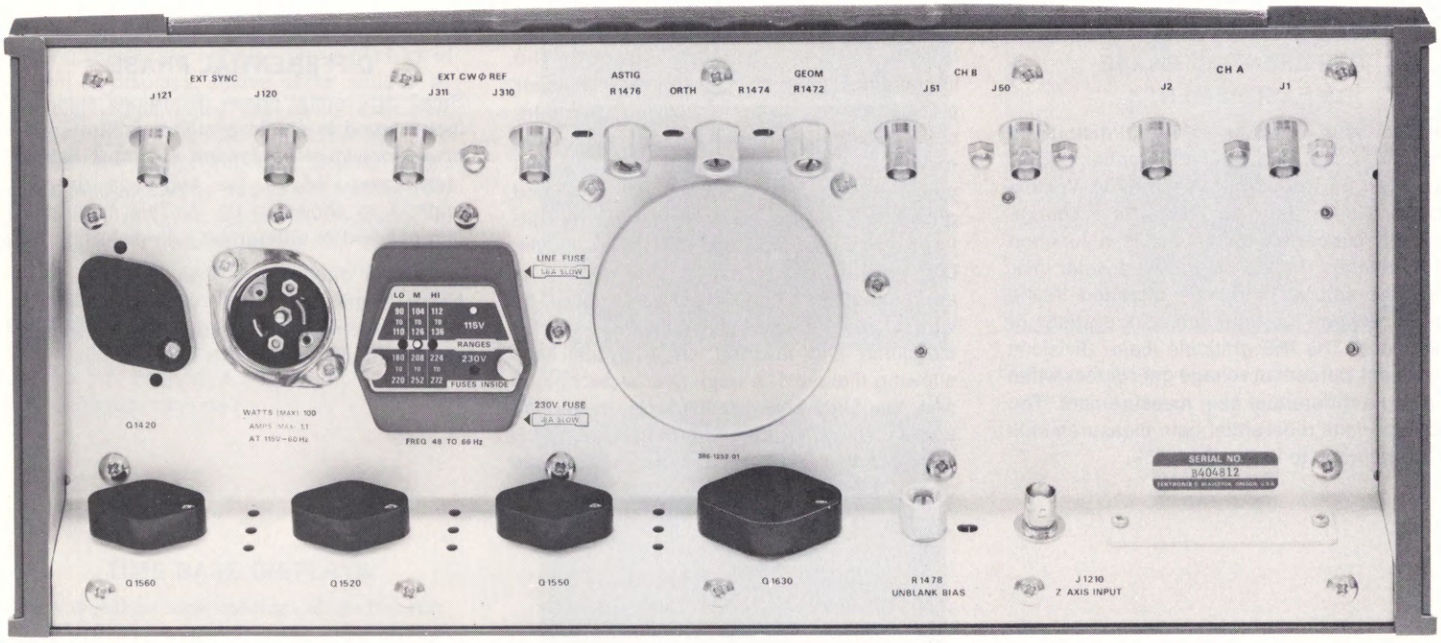


Figure 8. The direct-reading display of differential phase distortion using a single trace.



520A Rear Panel

CHARACTERISTICS

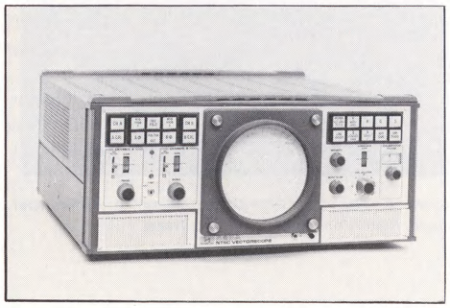
Graticule—Two separate graticules provide reference for vector and line sweep displays. The parallax-free vector graticule, or the luminance graticule, is automatically selected and edge-lighted concurrent with operating mode selection.

Z-Axis Input—The Z-AXIS INPUT connector accepts external trace-brightening pulses for intensifying a portion of the display during the time of interest.

Video Inputs—Dual BNC input connectors for each channel permit 75-Ω loop-through operation with a return loss greater than 46 dB* to 5 MHz. Amplitude range is 0.7 V to 1.4 V VIDEO (sync tip to peak white).

Power Requirements—90 to 136 Vac or 180 to 272 V ac, 47 to 63 Hz, 95 watts max at 115 V and 60 Hz. Rear panel selector provides rapid accommodation to six line-voltage ranges. Factory set at 115 Vac.

Environmental Capabilities—Listed instrument characteristics are valid over a temperature range of 0°C to +50°C ambient.



520A Cabinet Vectorscope

Mechanical Characteristics—The Vectorscope is available in two mechanical configurations, a cabinet model and a rackmount model. Both instruments are electrically identical. The rackmount model mounts in a 19-in rack and is provided with a slide-out assembly for convenient access to internal components.

	Cabinet		Rackmount	
Dimensions	**in**	**cm**	**in**	**cm**
Height	7	17.8	7	17.8
Width	16.9	42.9	19.8	50.2
Depth	19.2	48.7	19	48.3
Weight	**lb**	**kg**	**lb**	**kg**
Net	33	15	33	15
Shipping	≈61	≈27.7	≈61	≈27.7

Included Accessories—Smoke-gray filter, installed (378-0581-00); power cord (161-0036-00). Rackmount: Same as cabinet but includes rackmounting hardware, and slide-out assembly (351-0195-00).

*Exceeds CCIR recommendation 451-2, paragraph 3.1 and 3.2.

ORDERING INFORMATION

When ordering, please use the exact nomenclature as given here.

520A NTSC VECTORSCOPE (Cabinet)
R520A NTSC VECTORSCOPE (Rackmount)

OPTIONAL ACCESSORIES

75-Ω Voltage Step-Up Termination—The 75-Ω Voltage Step-up Termination provides a X5 increase in chrominance amplitude and permits Differential Gain and Differential Phase measurements to be made to a higher degree of accuracy when used with a TEKTRONIX Vectorscope. Input impedance to the termination is a constant 75 Ω. Use of the termination requires a source of external sync to the Vectorscope.

For use with 520A Vectorscope
UHF Connectors, order 011-0100-00
BNC Connectors, order 011-0100-01

Single Sideband Chroma Amplitude Corrector—The Single Sideband Chroma Amplitude Corrector is designed for use with a TEKTRONIX Vectorscope in transmitter applications where a vestigial sideband signal is being demodulated with a detecting diode. The corrector provides a X2 increase in chrominance amplitude and passes luminance components with little or no attenuation. Input impedance is 75 Ω.

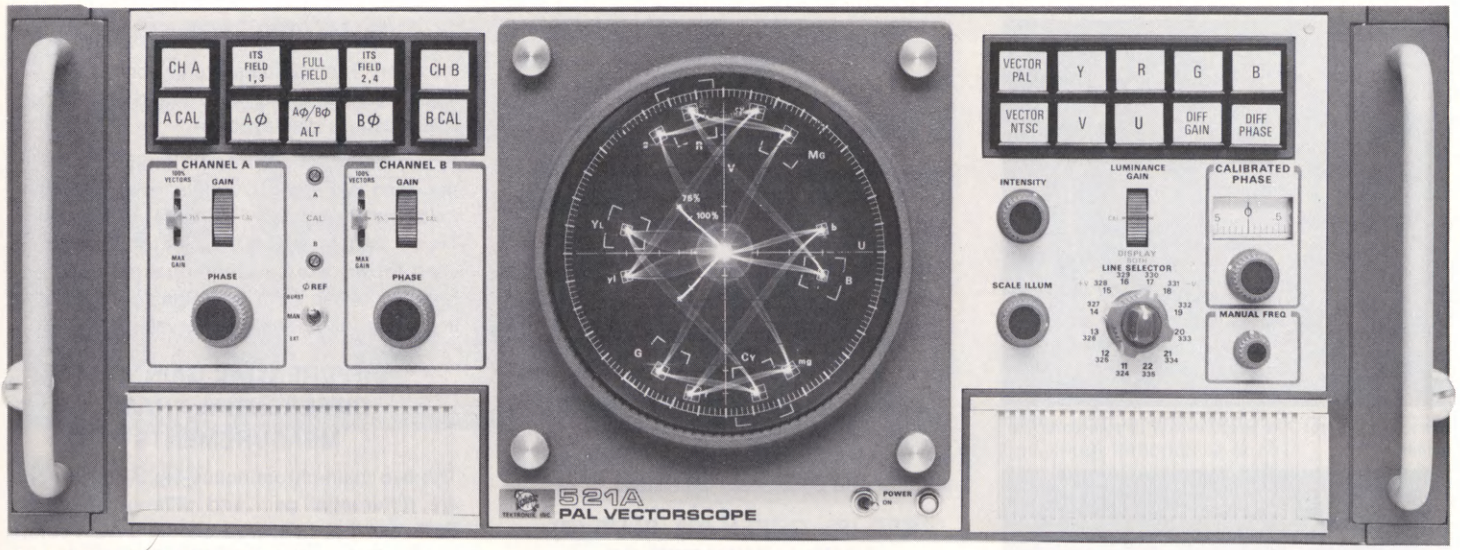
For use with 520A Vectorscope
UHF Connectors, order 011-0107-00
BNC Connectors, order 011-0107-01

Recommended Camera for display photographs: C-59-P with Adapter 016-0295-00. See camera section of catalog for information.

R520A Cradle Assembly—For mounting the 520A in a WECO backless rack.
Order 426-0667-00.

R521A PAL
R522A PAL-M

Consider this series for high resolution, dual-vector displays, vertical interval line selection and time-base displays.



R521A PAL (625/50 4.43 MHz)

R522A PAL-M (525/60 3.575 MHz)

MEASUREMENTS

Luminance Amplitude

Chrominance Phase

Chrominance Amplitude

Differential Phase

Differential Gain

The 521A is designed for 4.43 MHz subcarrier (PAL). The 522A is designed for 3.575 MHz subcarrier (PAL-M). The description of performance that follows applies to both the 521A and 522A unless noted.

VECTOR PRESENTATION

The vector presentation graphically displays the relative phase and amplitude of the chrominance signal on polar coordinates. To identify these coordinates the graticule (see fig. 1) has points which correspond to the proper phase and amplitude of the primary, complementary, and conjugate chrominance vectors: Red (R) (r), Green (G) (g), Blue (B) (b), Cyan (CY) (cy), Magenta (MG) (mg), and Yellow (YL) (yl).

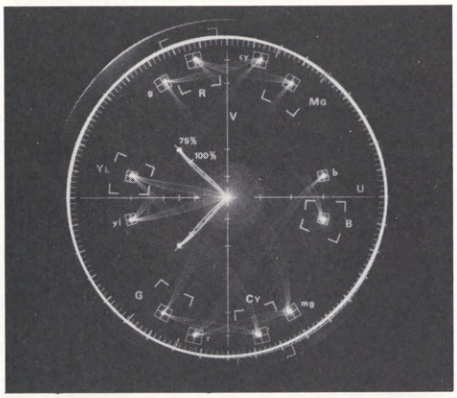


Figure 1A. Vector PAL presentation of PAL color bar signal.

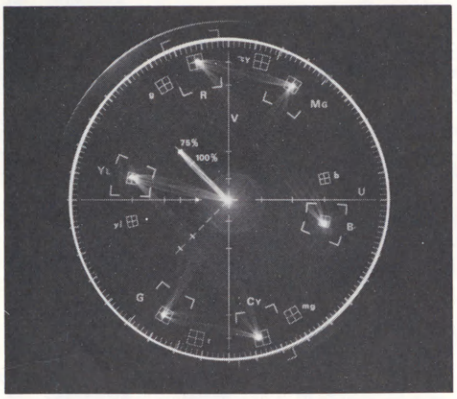


Figure 1B. Vector NTSC presentation of PAL color bar signal.

The outer boxes around the color points correspond to phase and amplitude error limits (± 10°, ± 20%). The inner boxes indicate ± 3° phase angle and ± 5% amplitude.

(+V), (+V and −V), and (−V) vector displays are provided, permitting observation of the 135° and 235° burst-related color information, individually or combined.

DUAL VECTOR DISPLAY

(As described for 520A Vectorscope)

TIME BASE

The linear time base operates at the line rate. Color signals are demodulated along any desired axis, U, V, etc., and displayed at the line rate on a linear time base.

RED (R), GREEN (G), BLUE (B), AND LUMINANCE (Y)

The PAL Vectorscope provides a luminance channel which permits the separation and display of the luminance (Y) component from the composite color signal. The Y component can also be combined with the output of the chrominance demodulators R, G, and B displays at a line rate. Amplitude measurements of color signal components can be made with an accuracy of 3%.

INSERTION TEST SIGNAL

Insertion Test Signals from front-panel selected lines of either field 1 and 3 or field 2 and 4 can be displayed.

Binary counters operate in conjunction with the field selector to select lines in either field that may carry suitable test signals. These circuits enable the Vectorscope to be used for measuring differential gain and differential phase from test signals transmitted in the vertical blanking interval.

DIFFERENTIAL GAIN AND DIFFERENTIAL PHASE MEASUREMENTS

The two main chrominance-signal distortions are differential gain and differential phase. Both can be measured on the PAL Vectorscope. Differential gain (fig. 2) is a change in color subcarrier amplitude as a function of luminance. In the reproduced color picture, the saturation will be distorted in the areas between the light and dark portions of the scene. The luminance graticule major divisions represent percent of voltage gain or loss when making a differential gain measurement. The PAL Vectorscope permits differential gain measurements with accuracy better than 1%.

Insertion Test Signal (ITS) color measurements during monochrome programming can be made by manually controlling regenerated subcarrier frequency (and phase) with the front-panel MANUAL FREQUENCY CONTROL.

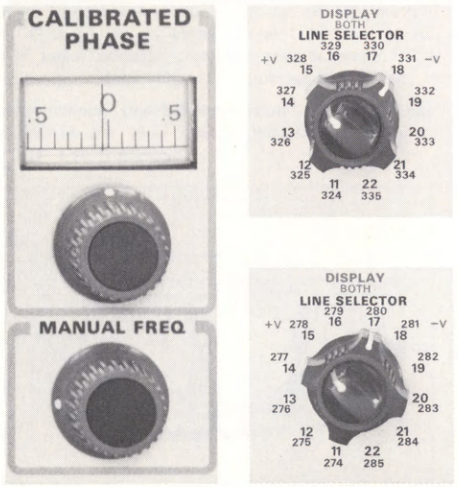


Figure 2. Differential Gain display. Minor divisions of graticule indicate 1% differential gain. Double exposure.

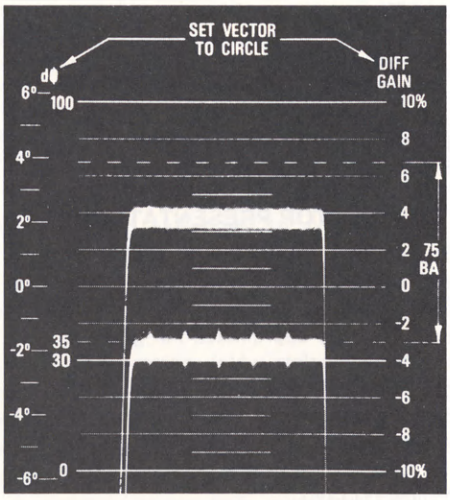
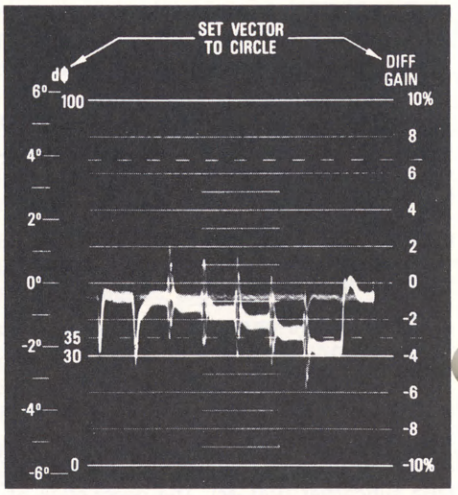
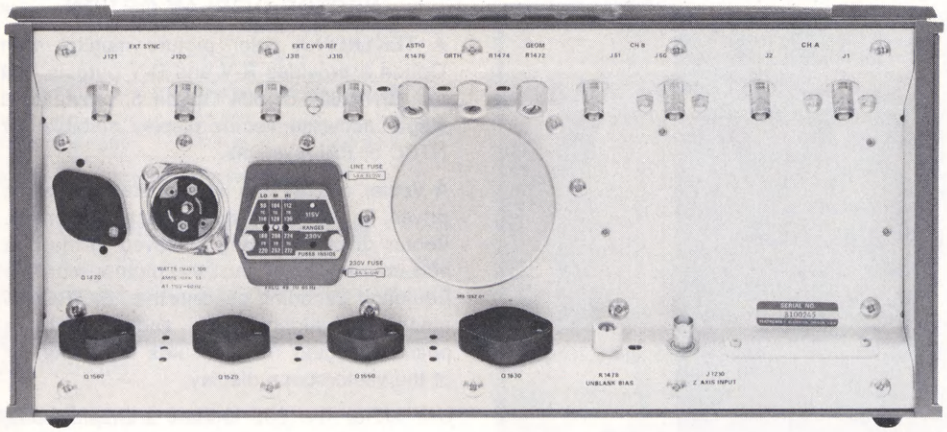


Figure 3. The direct-reading display of differential phase distortion using a single trace.





520A Series Rear Panel

Differential phase measurements are described in the 520A Vectorscope section of this catalog.

TWO METHODS OF MEASURING DIFFERENTIAL PHASE

Accurate measurement of small differential phase distortions by the two-trace overlay method is described in the 520A section.

A second direct-reading method (fig. 3) is better suited for larger differential phase measurements such as found in video tape recorders and microwave links.

CHARACTERISTICS

Graticule—Two separate graticules provide references for vector and line sweep displays. The parallax-free vector graticule, or the luminance graticule, is automatically selected and edge-lighted concurrent with operating mode selection.

Z-Axis Input—The Z-AXIS INPUT connector accepts external trace-brightening pulses for intensifying a portion of the display during the time of interest.

Video Inputs—Dual BNC input connectors for each channel permit 75-Ω loop-through operation with a return loss greater than 46 dB* to 5 MHz. Amplitude range is 0.7 V to 1.4 V VIDEO (sync tip to peak white).

Power Requirements—90 to 136 Vac or 180 to 272 V ac, 47 to 63 Hz, 95 watts max at 115 V and 60 Hz. Rear panel selector set for 115 Vac at factory.

Environmental Capabilities—Listed instrument characteristics are valid over a temperature range of 0°C to +50°C ambient.

Mechanical Characteristics—The Vectorscope is available in a cabinet model and a rackmount model. Both instruments are electrically identical. The rackmount model mounts in a 19-inch rack and is provided with a slide-out assembly for convenient access to internal components.

	Cabinet		Rackmount	
Dimensions	**in**	**cm**	**in**	**cm**
Height	7	17.8	7	17.5
Width	16.9	42.9	19	48.3
Depth	19.2	48.7	19.8	50.2
Weight	**lb**	**kg**	**lb**	**kg**
Net	33	15	33	15
Shipping	≈61	≈27.7	≈61	≈27.7

INCLUDED ACCESSORIES

Smoke-gray filter, installed (378-0581-00); power cord (161-0036-00).

Rackmount. Same as cabinet but includes rackmounting hardware, and slide-out assembly (351-0195-00).

ORDERING INFORMATION

When ordering, please use the exact nomenclature as given here.

521A PAL Vectorscope (Cabinet)

R521A PAL Vectorscope (Rackmount)

522A PAL-M Vectorscope (Cabinet)

R522A PAL-M Vectorscope (Rackmount)

*Exceeds CCIR recommendation 451-2, paragraph 3.1 and 3.2.

OPTIONAL ACCESSORIES

75-Ω Voltage Step-Up Termination—The 75-Ω Voltage Step-Up Termination provides a X5 increase in chrominance amplitude and permits Differential Gain and Differential Phase measurements to be made to a higher degree of accuracy when used with a TEKTRONIX Vectorscope. Input impedance to the termination is a constant 75 Ω. Use of the termination requires a source of external sync to the Vectorscope.

For use with 521A Vectorscope
BNC Connectors, order 011-0109-00

For use with 522A Vectorscope
UHF Connectors, order 011-0100-00
BNC Connectors, order 011-0100-01

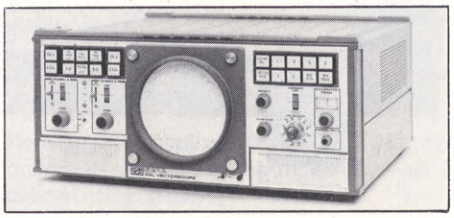
Single Sideband Chroma Amplitude Corrector—The Single Sideband Chroma Amplitude Corrector is designed for use with a TEKTRONIX Vectorscope in transmitter applications where a vestigial sideband signal is being demodulated with a detecting diode. The corrector provides a X2 increase in chrominance amplitude and passes luminance components with little or no attenuation. Input impedance is 75 Ω.

For use with 521A Vectorscope
UHF Connectors, order 011-0108-00
BNC Connectors, order 011-0108-01

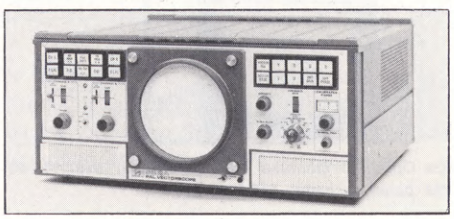
For use with 522A Vectorscope
UHF Connectors, order 011-0107-00
BNC Connectors, order 011-0107-01

R520A Cradle Assembly—For mounting the Vectorscope in a WECO backless rack.
Order 426-0667-00

Recommended Camera for display photographs: C-59-P with Adapter 016-0295-00. See camera section of catalog for information.



521A Cabinet Vectorscope

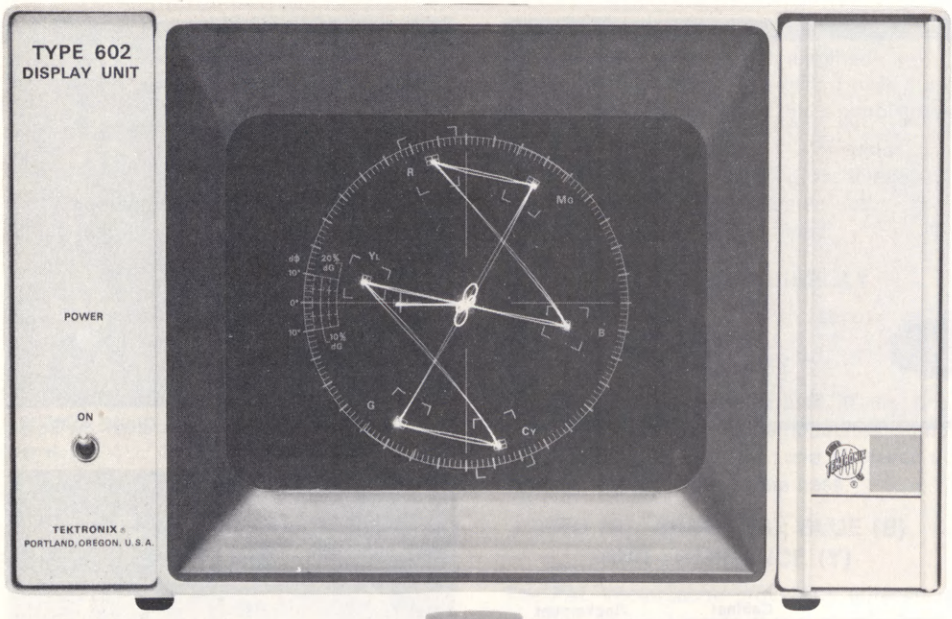


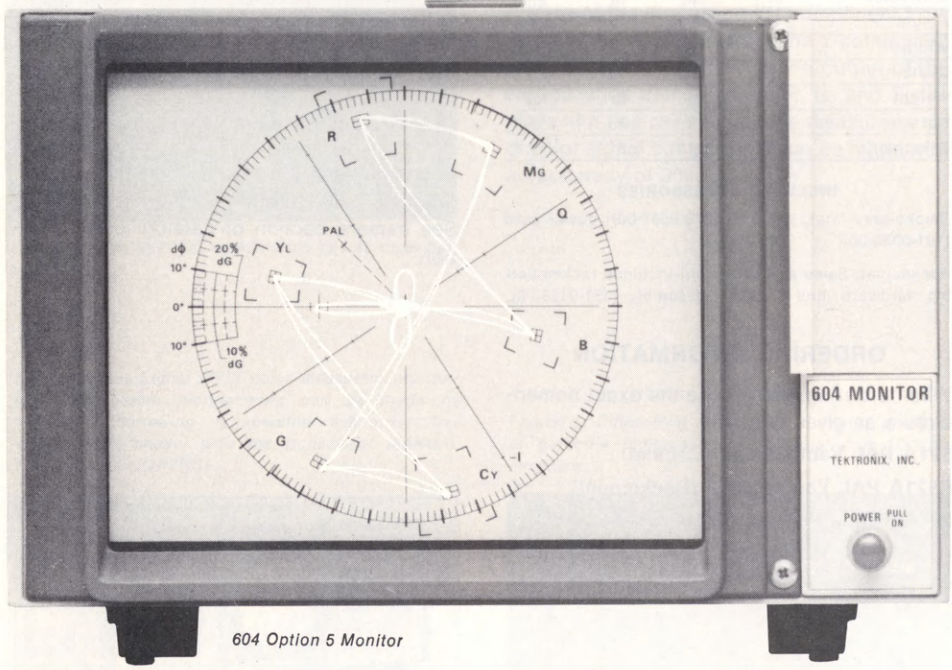
522A Cabinet Vectorscope

VECTORSCOPES

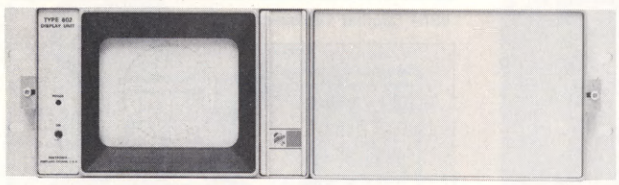
Accurate decoding in TEKTRONIX Picture Monitors (with Option 2) produce R-Y and B-Y drives for these vector display units.

NTSC OR PAL
602 OPTION 5
604 OPTION 5





604 Option 5 Monitor



602 Option 5 mounted in rack adapter 016-0115-02 with panel assembly 016-0116-00.

VECTOR DISPLAY OPTION

A TEKTRONIX color picture monitor with Option 2 provides R-Y and B-Y outputs that can drive 602 or 604 Option 5, providing a single accurate vector display suitable for NTSC or PAL systems.

A Vector display can be multistandard when driven by a multistandard picture monitor. Vector display phasing is slaved to the hue and chroma controls of the picture monitor. Equiband decoding used in the TEKTRONIX monitors is highly stable and accurate in phase and gain. This assures the accuracy of the vectorscope display.

Use either the 602 Option 5 Display Unit or the 604 Option 5 Display Monitor. (Option 5 provides a vectorscope graticule.)

602 OPTION 5 DISPLAY UNIT

With 5 in crt and an illuminated, internal vector-display graticule, this compact solid-state instrument has excellent resolution and provides accurate displays of information from x, y, and z signal inputs. This allows any 602 including Option 5 to be used as an x-y monitor in addition to vectorscope appiications.

CHARACTERISTICS

CRT DISPLAY

Cathode-Ray Tube—5 in flat-faced rectangular crt with P31 phosphor.

Vector Display Graticule—Internal, parallax-free, variable illumination.

VERTICAL AND HORIZONTAL AMPLIFIERS

Bandwidth—Dc to 1 MHz at 3-dB down.

Deflection Factor—Vertical: 90 mV/cm to 135 mV/cm, internally variable. Horizontal: 90 mV/cm to 110 mV/cm, internally variable. (Adjusted to match the R-Y and B-Y output of the 650 and 670 Series.)

Beam Position—Front panel vertical and horizontal position ranges permit setting zero signal position to any point on screen.

Input R and C—100 kΩ ± 10% paralleled by 30 pF or less.

Max Input Voltage—± 10 V (dc plus peak ac).

OTHER CHARACTERISTICS

Power Requirements—90 to 136 V ac or 180 to 272 V ac, 48 to 440 Hz. 50 watts at 115 V ac, 60 Hz. Rear panel selector provides rapid accommodation for six line-voltage ranges.

NTSC OR PAL
602 OPTION 5
604 OPTION 5

Dimensions and Weights (Cabinets Included)

Height	6.0 in	15.3 cm
Width	8.5 in	21.6 cm
Depth	17.4 in	44.1 cm
Net Weight	17.5 lb	7.9 kg
Shipping Weight	≈22.0 lb	≈9.9 kg

Included Accessories—Smoke-gray filter.

ORDERING INFORMATION

When ordering, please use the exact nomenclature as given here.

602 Option 5 Display Unit with Vector Display Graticule

Option 1 without Cabinet
(To delete cabinet order **602 Option 5** and **Option 1.)**

OPTIONAL ACCESSORIES

5¼ in rack adapter (016-0115-02); panel assembly (016-0116-00); two type 602's may be mounted side by side using an optional rack adapter.

C-59-P camera. See camera section of catalog for information.

604 OPTION 5 DISPLAY MONITOR

With 6½ in crt and a non-illuminated, internal vector-display graticule, this x-y oscilloscope provides easy viewing of displays at low cost.

CHARACTERISTICS

CRT DISPLAY

Cathode-Ray Tube—6½-in flat-faced rectangular crt with P31 phosphor.

VERTICAL AND HORIZONTAL AMPLIFIERS

Bandwidth—Dc to 2 MHz at 3-dB down (80% full screen scan).

Deflection Factor—Vertical and horizontal: ≈50 mV/div to 250 mV/div, internally adjustable, 5:1 fixed internal attenuator extends range to at least 1.25 V/div.

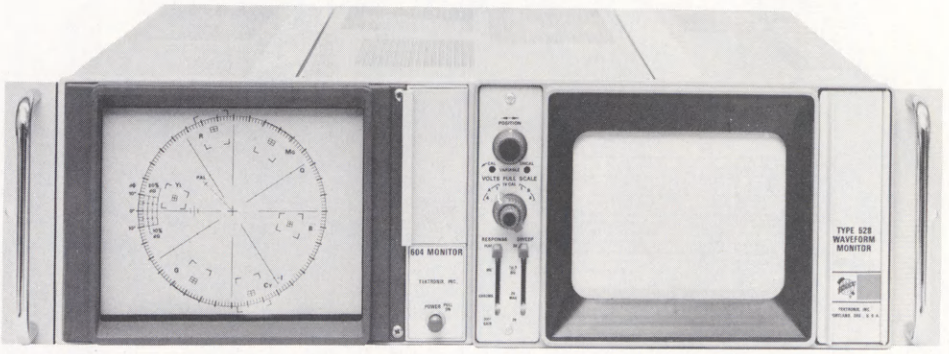
Input R and C—1 MΩ ± 1%, paralleled by less than 47 pF.

Beam Position—Front panel position controls permit setting zero to any point on screen.

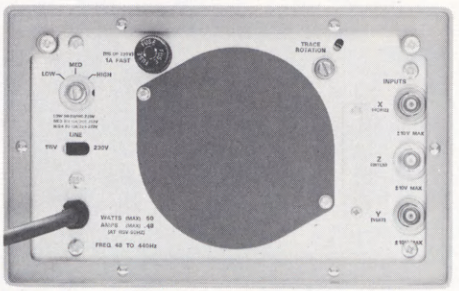
Max Input Voltage— ± 100 V (dc plus peak ac).

OTHER CHARACTERISTICS

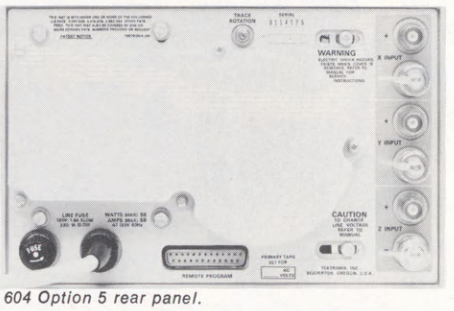
Power Requirements—Line voltage selector allows operation from 100, 110, 120, 220, and 240 V (± 10% of each range), 50 to 60 Hz and 400 Hz, 56W max at nominal line voltage.



604 Option 5 with Option 3 side by side with 528 Waveform Monitor in rackmount conversion kit 016-0337-00.



602 Option 5 rear panel.



604 Option 5 rear panel.

Dimensions and Weights (cabinet included)

Height	6.7 in	16.9 cm
Width	8.4 in	21.4 cm
Depth	19.3 in	48.9 cm
Net Weight	17.5 lb	7.9 kg
Shipping Weight	23.0 lb	10.4 kg

Included Accessories—External program connector (131-05700-00); connector cover (200-0821-00).

ORDERING INFORMATION

When ordering, please use the exact nomenclature as given here.

604 Option 5 Monitor with Vector Display Graticule

Option 3 without Handle and Feet
(To delete handle and feet, order 604 Option 5 and Option 3.)

For pricing information, see last page.

OPTIONAL ACCESSORIES

5¼ in rack conversion kit, C-5 Camera. See camera section of catalog for information.

RACKMOUNTING

Note: If rackmount conversion kit is to be used, be sure to order your 604 option 5 with the Option 3 deduction of handle and feet.

Cabinet-to-rackmount Conversion Kits, equipped with slide out assembly required to rackmount.

604 Option 5 with Option 3 in a Standard Rack Width includes securing hardware and blank front panel when only one instrument is utilized. **Order 040-0601-00.**

Two 604 Option 5 with Option 3 Side by Side in a standard rack width. **Order 040-0600-00.**

604 Option 5 with Option 3 Side by Side with 528 in a standard rack width. **Order 016-0337-00.**

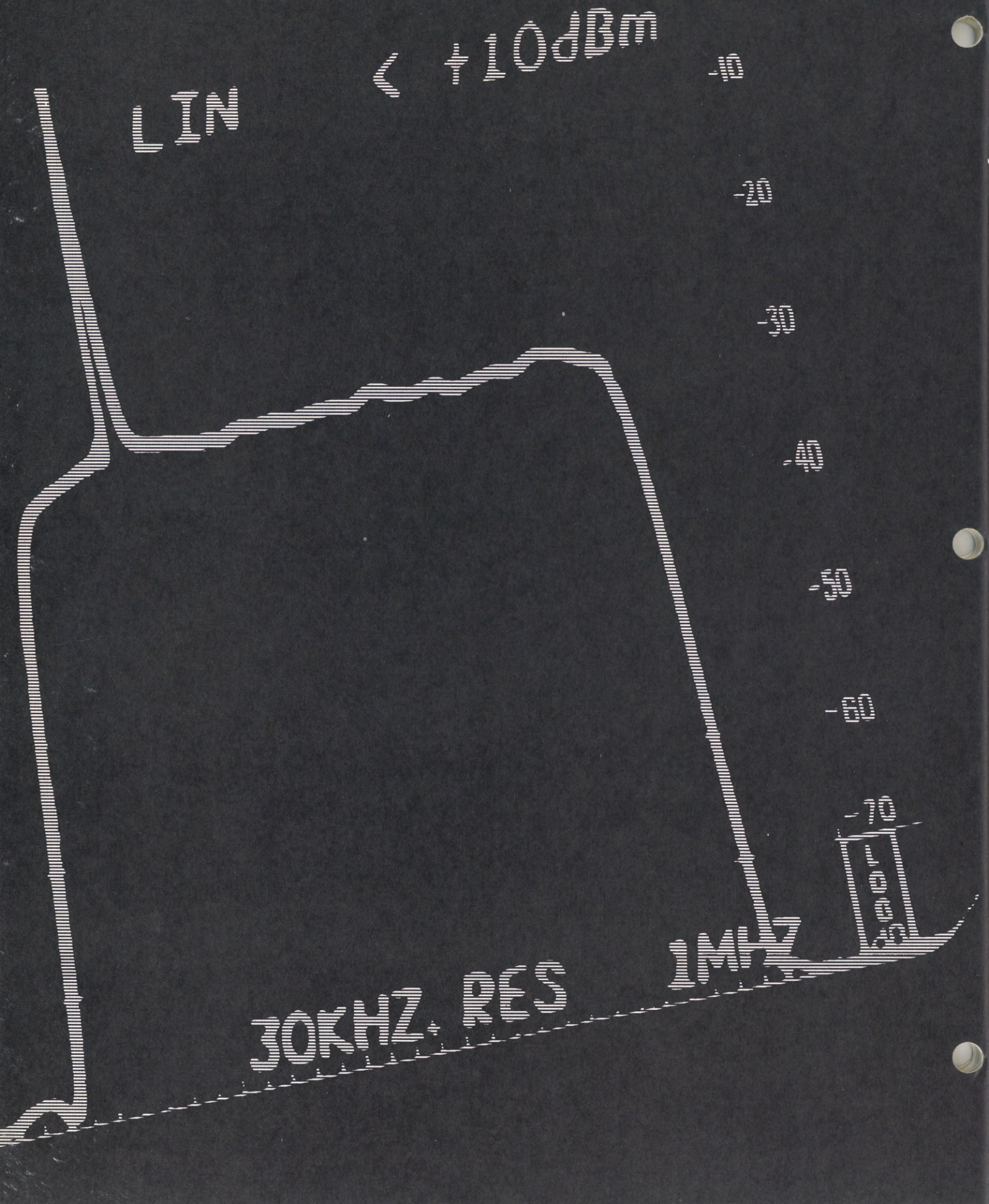
TM 503 Modular Test System and a 604 in a standard rack width. **Order 040-0624-00.**

Rackmount-to-cabinet Conversion Kit required to convert a rackmount 604 to a cabinet style. **Order 040-0602-00.**

Complete information on 650 series and 670 series color picture monitors is presented in the monitor section of this catalog.

It is suggested that you discuss these products and your system requirements before ordering. This will insure complete mounting and operational compatibility.

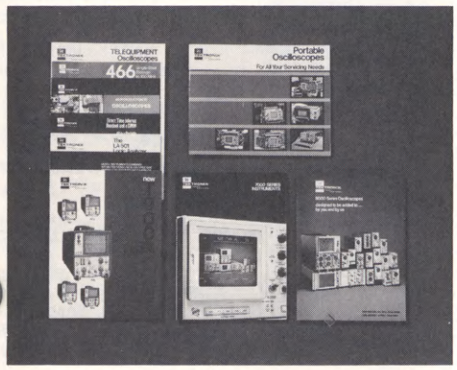
OTHER TV PRODUCTS



When you work with signals that are not one volt of video across 75 ohms, our other products will be of interest.

OTHER TELEVISION PRODUCTS

When you work with signals that are not one volt of video across 75 ohms, our **other** products will be of interest. This section provides an overview of these **other** products, plus some details about selected items that we feel will be of particular interest to the Television Industry and to the industries that use television. The complete reference for other Tektronix products is the General Catalog. To get the Tektronix General Catalog use the response card in this publication (U.S. only).



OSCILLOSCOPES

The scope is a universal tool in any facility that has to analyze an electrical signal. Where this signal is not video, or deviates from standard level, composite video, a general purpose oscilloscope will be required. When a general purpose scope will also be used for video you should consider an instrument with a TV triggering mode. Normal scope triggering is level and slope sensitive and **does not** recognize vertical and horizontal sync pulses. Whether that scope should be a portable or a plug-in laboratory type depends on your present needs and consideration of what you may have to do tomorrow. Whatever your choice, be sure the triggering functions are suited for your job.

SPECTRUM ANALYZERS

Today, more than ever, performance evaluation of your (audio, video, and rf) systems requires accurate measurement in the frequency domain. Selected Tektronix spectrum analyzers are detailed on the following pages along with their associated tracking and sweep generators. These units are particularly well suited to sideband analysis, modulation analysis, and audio distortion analysis. Descriptions of the oscilloscope mainframes in which these products operate will be found in the Tektronix General Catalog.

MODULAR INSTRUMENTS

The TM500 Series consists of a number of mainframes that accept modular counters, digital multimeters, signal sources, power supplies, signal processors, and oscilloscopes. With the TM500 Series you can select a package of instruments to meet your individual needs today. Tomorrow you can change or expand the package to fit your needs. See the Tektronix General Catalog for details.

TIME DOMAIN REFLECTOMETER

Cable fault location by time domain reflectometry (TDR) is an effective way to find opens, shorts, and impedance mismatches. The Tektronix 1502 and 1503 TDR Cable Testers use TDR to locate faults quickly and conveniently. They are portable, battery-operated units with a CRT for observation and an optional built-in chart recorder for permanent records. Resolution approaches one-half inch with the 1502 with a distance range of greater than 1000 feet. The 1503 has a range of 50,000 feet. The General Catalog should be checked for full specifications.

OSCILLOSCOPE CAMERAS

All scope-type cameras recommended for use with waveform monitors and vectorscopes are fully described in this section. Additional information on scope-type cameras will be found in the Tektronix General Catalog.

DIGITAL PHOTOMETER

The Tektronix J16-TV described in this section, is a portable device used for adjusting picture monitor color-temperature. Other applications include measurement of studio and other lighting levels.

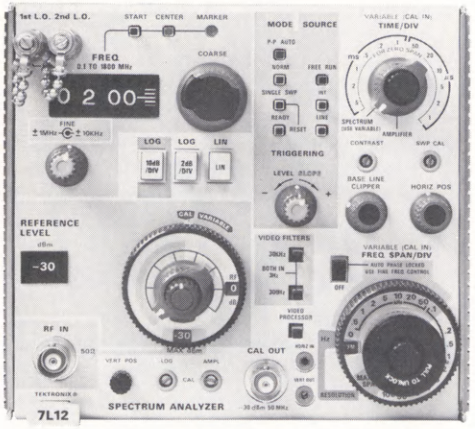
ADDITIONAL TEKTRONIX PRODUCTS

Tektronix also makes curve tracers, automatic test systems, display products, terminal and calculator products, medical products, and accessories.

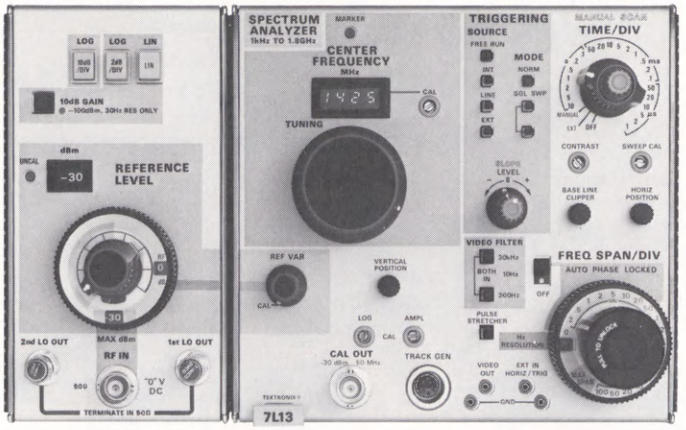
SPECTRUM ANALYZERS

7L12
7L13

For broadcast proof-of-performance, day-to-day maintenance, and monitoring requirements.



7L12 100 kHz to 1800 MHz



7L13 1 kHz to 1800 MHz

7L12

100 kHz to 1800 MHz In One Display

300 Hz to 3 MHz Resolution

—115 dBm Sensitivity

Fully Calibrated Displays

4:1 Resolution Bandwidth Shape Factor

70 dB Dynamic Range

IM Distortion 70 dB Below Full Screen

Spurious Free Operation

Automatic Phase Lock

The 7L12 Spectrum Analyzer is a modern, high performance, swept front end type of analyzer covering the frequency range up to 1.8 GHz. The unit employs phase lock stability and an ample selection of resolution bandwidths in an economical field or laboratory instrument.

The unit has a 3 MHz resolution mode for accurate measurement of pulse phenomena; the zero-span mode may be used to present a demodulated display of a signal for time domain measurements. A 4:1 resolution bandwidth shape filter introduced by TEKTRONIX permits close-in measurements not possible with conventional filters. Noise measurements are also easily made due to the high sensitivity, video filters, and equivalent resolution and noise power bandwidth of the instrument.

The 7L12 fills two holes in any 3- or 4-hole 7000-Series Mainframe and features a complete time base so that other oscilloscope or time domain plug-ins may be used simultaneously. As with all 7000-Series plug-ins, CRT READOUT will display the major parameters. For the 7L12 these include: reference level, dB/div, frequency span, and resolution.

7L13

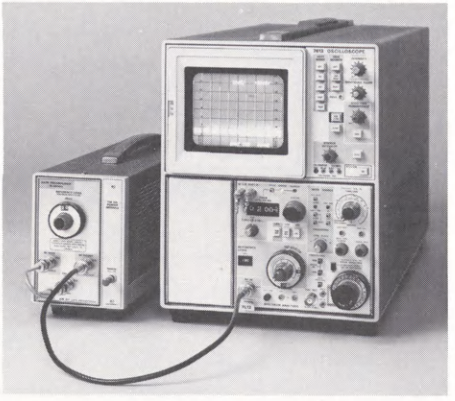
1 kHz to 1800 MHz in One Display

30 Hz to 3 MHz Resolution

—128 dBm Sensitivity

The 7L13 spectrum analyzer represents the highest performance possible today in an instrument of this frequency range and price. The fm stability is 10 Hz, making 30 Hz resolution possible across the entire frequency range.

This analyzer is a high quality laboratory instrument. In addition to incorporating the standard features of the 7L12, it has crt readout of the center frequency, and an UN-CAL light to indicate incorrect settings of the sweep rate or resolution controls.



The 7L12 is shown in a 7613 variable persistence mainframe connected to the AM511 vhf preamplifier for extra sensitivity.

CHARACTERISTICS

Apply to both 7L12 and 7L13 except where noted.

FREQUENCY CHARACTERISTICS

Range — 7L12 range is 100 kHz to 1.8 GHz. 7L13 range is 1 kHz to 1.8 GHz.

Resolution Bandwidth — Selections from 300 Hz to 3 MHz (7L12) and 30 Hz to 3 MHz (7L13). Shape factor 60 dB to 6 dB is 12:1 or better for 30 Hz resolution and 4:1 or better for 300 Hz to 3 MHz resolution.

Stability — (7L12) after 2 hour warm-up, within 50 kHz, over a one hour period at a fixed temperature, when phase locked. Within 100 kHz, when not phase locked, over a one hour period, at a fixed temperature. (7L13) after a 2 hour warm-up. Within 2 kHz, over a one hour period at a fixed temperature, when phase locked. Within 100 kHz, when not phase locked, over a one hour period, at a fixed temperature.

Incidental FM — (7L12) — 200 Hz (p-p) max when phase locked. 20 kHz (p-p) max when not phase locked. (7L13) — 10 Hz (p-p) max when phase locked. 20 kHz (p-p) max when not phase locked.

AMPLITUDE CHARACTERISTICS

Reference Level Range — Calibrated levels in decade steps from —100 dBm to +30 dBm, within ±2 dB extended to —110 dBm to +30 dBm in the 7L13. An UNCAL indicator shows when excessive sweep speeds are selected on the 7L13.

Log 10dB/div: 70 dB dynamic range. Accuracy ±0.1 dB/dB to a max of 1.5 dB.

Log 2 dB/div: 14 dB dynamic range. Accuracy ±0.4 dB/2 dB to a max of 1.0 dB.

Linear: Provides a linear display, within 10%.

CW Sensitivity — (Signal + noise = twice noise in LIN Mode). —128 dBm at 30 Hz (7L13 only), —115 dBm at 300 Hz, —108 dBm at 3 kHz, —100 dBm at 30 kHz, —90 dBm at .3 MHz, —80 dBm at 3 MHz. Sensitivity may decrease by 2 dB at 1.7 GHz and 4 dB at 1.8 GHz.

Flatness — Over any frequency span, +1 dB, —2 dB (7L13), and ±1.5 dB (7L12).

Intermodulation Distortion — Third order down 70 dB or more from two —30 dBm signals within any frequency span. Second order down 70 dB or more from two —40 dBm signals.

Internal Spurious Signals (residual response) — Equal to or less than —100 dBm.

7L12
7L13

Dynamic Range — Range 70 dB for 7L12, 80 dB for 7L13, when operating with 30 Hz resolution bandwidth. The VARIABLE control provides gain adjustment between any two 10 dB steps.

INPUT CHARACTERISTICS

Impedance — 50 Ω, nominal.

SWEEP CHARACTERISTICS

Frequency Span — 500 Hz/div to 100 MHz/div (7L12). Calibrated steps in 1-2-5 sequence from 200 Hz/div to 100 MHz/div (7L13). A MAX SPAN position provides approx 1.8 GHz (180 MHz/div of span), and a 0 position provides fixed frequency operation for time domain display.

Sweep Modes and Rate — 5 ms/div to 1μs/div (7L12). Selection of an external sweep source, manual sweep, or calibrated time base, 10 s/div to 1 μs/div (7L13).

Triggering — Trigger signal source can be external, internal, or line voltage.

OUTPUT CONNECTIONS

Calibrator — 50 MHz, −30 dBm from 50 Ω.

Vert Out — (Video Out on 7L13) approx 2 V full screen.

Horiz In — (and Trig on 7L13) for use with chart recorder.

Tracking Gen (Logic) 7L13 — for use with tracking generator (5VTTL).

1st LO — for use with tracking generator or 1405 Sideband Analyzer.

2nd LO — for use with tracking generator.

ORDERING INFORMATION

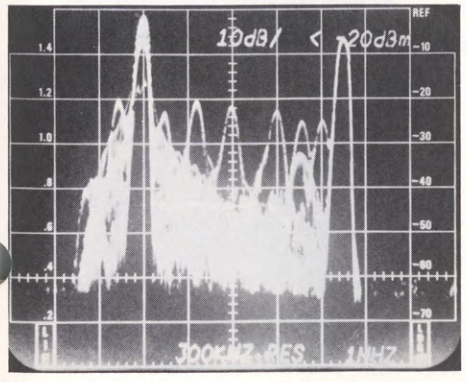
7L12 SPECTRUM ANALYZER

7L13 SPECTRUM ANALYZER

7603 MAINFRAME
Option 77 P7 Phosphor and Internal S.A. Graticule

7613 Variable Persistence MAINFRAME
Option 6 Internal S.A. Graticule

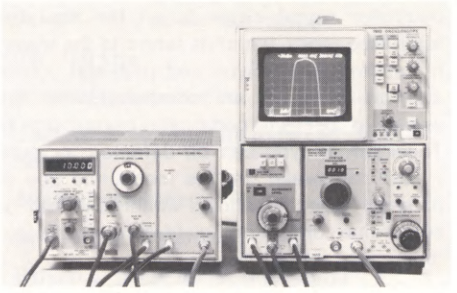
Note about Mainframes, Phosphors, and Graticules — 7000-Series Mainframes, except storage versions, are normally shipped with P31 phosphor. Slow swept displays sometimes are more easily viewed with P7 phosphor (an option with most mainframes). External spectrum analyzer graticules for 7000-Series Mainframes come with the units (see included accessories). See mainframe specification (not on this sheet) for availability of crt option with internal spectrum analyzer graticules.



Spectrum Analyzer Display of a VIT Signal.

TR 501
TR 502

TRACKING GENERATORS



The TR 502 Tracking Generator is used with the Tektronix 7L13 Spectrum Analyzer to make swept frequency tests and precise frequency measurements.

Wide Frequency Range — 1800 MHz

System Stability
10 Hz (TR 502 w/7L13)
200 Hz (TR 501 w/7L12)

Amplitude Steps of 1 dB
to −59 dBm (TR 502 w/7L13)
to −11 dBm (TR 501 w/7L12)

Resolution
30 Hz (TR 502 w/7L13)
300 Hz (TR 501 w/7L12)

Plus — TR 502 has automatic counter dot marker when used with DC 502 and 7L13.

The TR 502 and TR 501 Tracking Generators work with the 7L13 and 7L12 Spectrum Analyzers to provide constant level, calibrated RF sources for swept frequency tests to 1800 MHz.

When used as a cw source, with the analyzer in a zero span (non-swept) mode, the TR 502/7L13 system has 10 Hz stability. (The TR 501/7L12 system has 200 Hz stability). This exceptional stability enhances the dynamic range capability of the analyzer, tracking generator combination.

The Tracking Generator Aux RF output may be used to drive a frequency counter. Frequencys up to 1800 MHz may be measured accurately in the presence of high level adjacent signals to the sensitivity limits of the analyzer. TR 502/7L13 sensitivity is −128 dBm at 30 Hz resolution bandwidth. (TR 501/7L12 sensitivity is −115 dBm at 300 Hz resolution bandwidth). When the TR 502 is used with the 550 MHz DC 502 frequency counter the spectrum display center frequency, indicated by a bright dot, is automatically counted.

The Tracking Generator sweep rates are controlled from the spectrum analyzer. The output level is controlled from the Tracking Generator. The output frequency of the Tracking Generator is the same as the frequency of the analyzer at any instant of the sweep.

The Tracking Generator is a two-wide unit compatible with the TM 500 Modular Instrument Series. When powered by a TM 503, there is room for a 550 MHz DC 502 or other counter.

CHARACTERISTICS

Apply to both the TR 502/7L13 and TR 501/7L12 except where noted.

FREQUENCY CHARACTERISTICS

Range — 0.1 MHz to 1800 MHz.

Resolution Bandwidth — 30 Hz to 3 MHz (TR 502/7L13). 300 Hz to 3 MHz (TR 501/7L12).

Stability — 10 Hz p-p (TR 502/7L13). 200 Hz p-p (TR 501/7L12).

AMPLITUDE CHARACTERISTICS

RF Output Amplitude — 0 dBm to −59 dBm in 10 and 1 dB steps plus 2 dB vernier (TR 502/7L13). 0 dBm to −11 dBm in 1 dB steps plus 2 dB vernier (TR 501/7L12).

Auxiliary Output Level — 0.1 V RMS in 50 Ω.

Flatness — ±2.0 dB (TR 502/7L13). ±3.0 dB (TR 501/7L12).

Spurious Output —
Harmonic: > 20 dB below carrier.
Non-Harmonic: > 40 dB below carrier.

Dynamic Range — > 110 dB (TR 502/7L13). > 100 dB (TR 501/7L12).

SWEEP CHARACTERISTICS

Frequency Span — 200 Hz/div to 180 MHz/div (TR 502/7L13). 500 Hz/div to 180 MHz/div (TR 501/7L12).

OUTPUT CONNECTORS

RF Out — 50 Ω nominal impedance, vswr 2:1 or less.
Aux RF Out — for use with frequency counter.

ORDERING INFORMATION

TR 502 Tracking Generator

TM 503 Option 7 Power Module

Suggested Complimentary Items

DC 502 Option 7 (Includes Option 1 High Stability)
Digital Counter
or
016-0195-01 Blank Panel

TR 501 Tracking Generator

TM 503 Power Module

Suggested Complementary Items

DC 502 Digital Counter
or
016-0195-01 Blank Panel

015-1002-00 14 dB, 3 mm Attenuator; (used in the 2nd L.O. input line to improve TR 501/7L12 isolation).

Note: Existing 7L12 Spectrum Analyzers, if not already factory equipped for use with the TR 501, may be modified. Contact your Tektronix Representative for information.

TELEVISION SIDEBAND ADAPTER

NEW 1405

1405 TELEVISION SIDEBAND ADAPTER

Response of Transmitter Under Test within ±0.2 dB

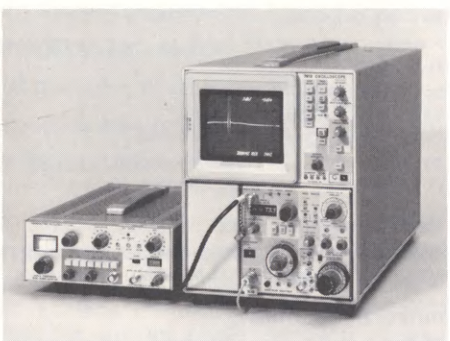
Frequency Response of RF and IF Circuits for Transmitters with Frequency to 1 GHz

Video Circuits Can Be Swept (0-15 MHz)

For In-Service Testing, Use of External Blanking Allows Either Full-Field or Single-Line Operation

Check Aural FM Deviation with Built-in Bessel NULL Technique

Flexible Marker System Will Accept Standard Crystals



The 1405 is used with a spectrum analyzer, such as the 7L12 or 7L13, to analyze the sideband response of a television transmitter. The 1405 generates a composite video signal, the "picture" portion of which is a constant-amplitude sineusoidal signal that sweeps 15-0-15 MHz. This signal is applied as modulation to a television transmitter; the output is then displayed on the spectrum analyzer, and appears as the response curve of the transmitter under test. The 1405/ spectrum analyzer combination will display the frequency response characteristics of RF and IF circuits for transmitters with frequencies to 1 GHz. Video circuits (zero frequency offset) can also be analyzed.

The swept portion of the 1405 output signal is sinusoidal about zero frequency, and is generated by offsetting the 7L12 or 7L13 first local oscillator signal. The first local oscillator signal depends on the analyzer input frequency, which is tuned to the transmitter frequency. Sync and pedestal pulses and cw blanking are combined with the sweep to form the composite output signal. The internal sync can be defeated for pure sinusoidal sweep. In this mode, the use of external blanking allows either full-field or single-line operation, a feature useful for in-service testing.

The output amplitude of the cw portion of the composite video signal can be varied from 0 to 100 IRE in 10 IRE steps. The average picture level (APL) can also be varied in 10 IRE steps from 0 to 100 IRE. Three variable APL levels are provided for rapid checks at preset levels. If a combination of cw amplitude and APL exceeds normal tv transmitter modulation limits, internal logic will clamp the APL to 50 IRE and light an UNCAL indicator as a caution.

Five marker frequencies related to tv transmission standards are provided; a sixth marker oscillator is available for a user-provided crystal. The intensity and width of the displayed markers are adjustable.

Another feature of the 1405 is the variable-amplitude 10.396 kHz signal output, which can be used to check the aural FM deviation. When this signal is applied to a transmitter's aural input at the amplitude that produces the first carrier null, it corresponds to ±25 kHz of frequency deviation, or 100% modulation.

CHARACTERISTICS

The following characteristics apply to the 1405 and 1405/7L12 or 7L13 combination. They are applicable over the environmental specification limits for the 1405 and 7000-Series Mainframes.

FREQUENCY (Frequency Offset)

Range — will tune and provide a swept video output for a 7L12 or 7L13 center frequency range of 0 to 1 GHz.

Frequency Dial Accuracy — dial reading is within 40 MHz of transmitter frequency when properly tuned.

Fine Tuning Range — from ±0.5 MHz to ±1.25 MHz, depending upon transmitter frequency setting.

Tuned Frequency Drift — less than 1 MHz per hour after a 30 minute warm-up.

OUTPUT SIGNAL LEVEL

Amplitude (Sync Off) — 100 IRE equals 0.714 V p-p when terminated in 75 Ω.

Output Impedance — 75 Ω ±1% at 100 IRE and ±2% from 0 to 90 IRE.

Variable — 0 to 100 IRE in 10 IRE steps.

Accuracy (at 200 kHz) — ±1 IRE at 100 IRE; ±2 IRE from 10 IRE to 90 IRE.

Output Level During Blanking — 0 V ±0.01 V at 0 IRE; 0 V ±0.04 V at 100 IRE from 0 to 1 MHz; 0 V ±0.02 V at 100 IRE above 1 MHz.

CW Output Harmonics — down 40 dB or more.

FLATNESS

1405 — within ±0.1 dB from 100 kHz to 10 MHz, within ±0.2 dB from 10 MHz to 15 MHz, within ±0.4 dB from 50 kHz to 20 MHz.

1405 plus 7L12 or 7L13. For transmitter frequency greater than 20 MHz — within ±0.2 dB from 100 kHz to 10 MHz of picture carrier, increasing to ±0.3 dB at 15 MHz; within ±0.5 dB from 50 kHz to 20 MHz. For transmitter frequency of 0 to 20 MHz — within ±0.5 dB from 100 kHz to 15 MHz.

System Span — ≥200 kHz per division.

Video Frequency Range — 15-0-15 MHz.

AVERAGE PICTURE LEVEL (APL)

Variable — 0 to 100 IRE in 10 IRE steps.

Accuracy — ±2 IRE.

Three Preset Levels — PRESET A: 0 to 50 IRE. PRESET B: 25 IRE to 75 IRE. PRESET C: 50 IRE to 100 IRE.

HORIZONTAL SYNC, BLANKING, AND PEDESTAL DURATION — within NTSC limits (no vertical interval is provided). Transition time is 0.24 μs ±10%, from 10% to 90% points. Will also work on most international standards.

Composite Sync Source Blanking — 0 V turns cw on, greater than −5 V turns cw off.

Line Strobe — TTL pulse from 0 to 5 V turns cw on.

MARKERS AND Z-AXIS OUTPUT

Marker Frequencies (NTSC Marker Option) — 0.75 MHz, 1.25 MHz, 3.58 MHz (color subcarrier), 4.18 MHz, and 4.75 MHz.

Accuracy — ±0.01% of frequency selected (crystal controlled). Additional marker oscillator accepts user-supplied crystal*.

External Marker Input — accepts 0.2 MHz to 10 MHz, 1 V RMS nominal.

Z-Axis Output Amplitude — up to about +10 V and −3 V into 500 Ω. Minus voltage intensified markers.

AURAL OUTPUT

Output Frequency — 10.396 kHz, 0.01% (crystal controlled).

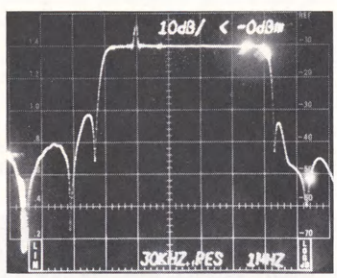
CW Output — Amplitude variable up to at least +12 dBm into 600 Ω. Harmonics down 45 dB or more.

***Crystal Requirements** — Series resonant; R_s less than 2000 Ω; Q greater than 5000; Case, HC/6U or HC/25U.

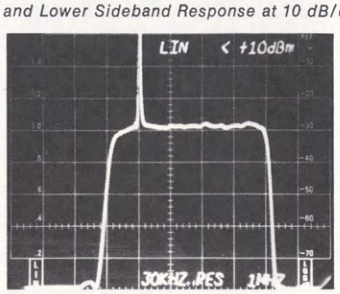
ORDERING INFORMATION

1405 Television Sideband Adapter (International)

1405 Television Sideband Adapter (NTSC Marker Option)



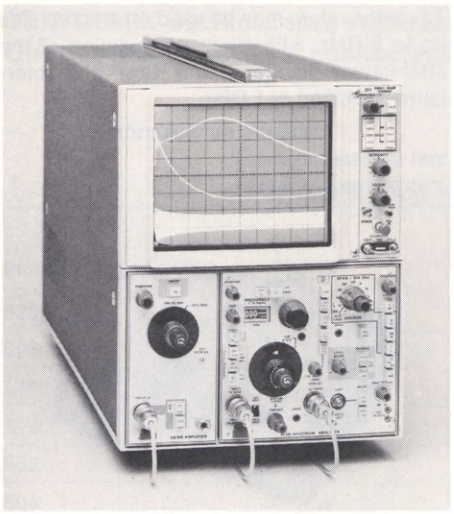
Upper and Lower Sideband Response at 10 dB/div.



Linear Display of Transmitter Flatness.

5L4N
7L5

SPECTRUM ANALYZERS



A dual-trace oscilloscope and analyzer display of frequency response using the 5L4N in a 5103N/D11 Mainframe with 5A15 Vertical Amplifier.

5L4N FEATURES

0 to 100 kHz

Selectable Impedance

Calibrated Appropriate to Impedance Selected

Single-Ended Input

Differential (Balanced) Input

Dynamic Range 80 dB (Full 8 div) Dynamic Range

Intermod >70 dB Down

Resolution Bandwidth 10 Hz to 3 kHz

Auto Resolution

Built-in Tracking Generator 20 Hz to 20 kHz Log Sweep*

The 5L4N is a 0- to 100-kHz spectrum analyzer that offers both high performance and economy. The analyzer features selectable input impedances, 80 dB of dynamic range, and a built-in tracking generator.

*100 Hz to 100 kHz also available.

This analyzer is especially suited for noise and distortion studies in the audio range, and comes equipped for 20 Hz to 20 kHz log sweeps.

The 5L4N can be used with any 5000-Series Oscilloscope Mainframe. Only two compartments are occupied by the analyzer so that, with the addition of a vertical plug-in, basic oscilloscope functions may be obtained. We recommend the use of a 5103N/D11 Storage Oscilloscope for maximum utilization of the analyzer.

ORDERING INFORMATION

5L4N Spectrum Analyzer
We recommend that the plug-in 5L4N be ordered with a storage mainframe.

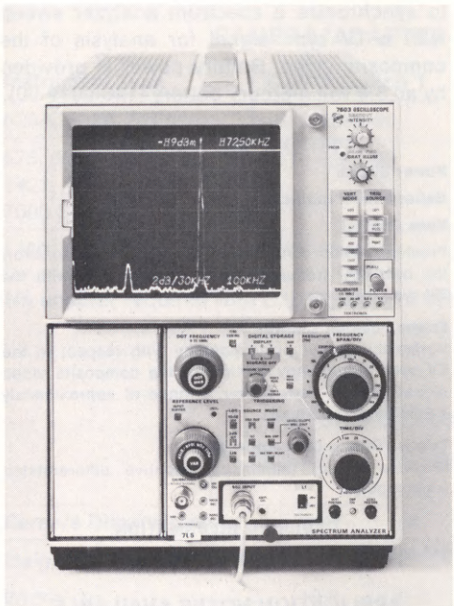
5103N/D11 Storage Oscilloscope, order 5111 (cabinet)

R5103N/D11 Storage Oscilloscope, order R5111 (rackmount)

Optional Plug-Ins for Time Domain Use

5A15N Single Trace Amplifier

5B10N Time Base Amplifier



New TEKTRONIX 7L5 5MHz Spectrum Analyzer combines synthesizer with digital technology for exceptional frequency accuracy. It is shown in a 7603 Mainframe.

7L5 FEATURES

THREE-KNOB OPERATION makes the 7L5 the world's easiest-to-use spectrum analyzer.

SYNTHESIZER STABILITY for six-digit accuracy of center frequency setting with virtually no drift.

DIGITAL STORAGE AND AVERAGING of display signals.

REFERENCE LEVEL SELECTION in 1-dB steps.

ABSOLUTE CALIBRATION in dBm, dBV, or volts/div.

CHANGEABLE INPUT IMPEDANCE MODULES to accommodate any impedance requirement.

WIDE DYNAMIC RANGE and nanovolt sensitivity.

PRESET REFERENCE LEVEL for extra input protection.

CRT READOUT of all major parameters.

7L5 digital storage provides clean, easy-to-see, easy-to-photograph displays with any 7000-Series crt readout mainframe.

Choose from these display and storage modes:

— Display peak or average of signal with continuously variable threshold shown by crt cursor.

— Store maximum levels of time varying signals.

— Split memory into A and B sections for comparing signals.

— Bypass digital storage for conventional display.

The new 7L5 5MHz spectrum analyzer has exceptional frequency accuracy, stability, and 6-digit resolution thanks to a combination of synthesizer and digital technology.

Operation is easy with crt readout of display parameters and with sweep time and resolution automatically optimized for each span position.

7L5 performance characteristics include: 80 dB on-screen dynamic range, 10 Hz resolution, and absolute calibration in dBm, dBV, or volts. The reference level is set and read out in 1-dB steps over the range of −128 dBm to +21 dBm (with L1 50 Ω plug-in module).

ORDERING INFORMATION

7L5 Spectrum Analyzer
(Spectrum Analyzer Requires L Plug-in Module)

L1 Plug-in Module (50 Ω)

L2 Plug-in Module (75 Ω)

***7603 Oscilloscope**

***R7603 Oscilloscope (Rackmount)**

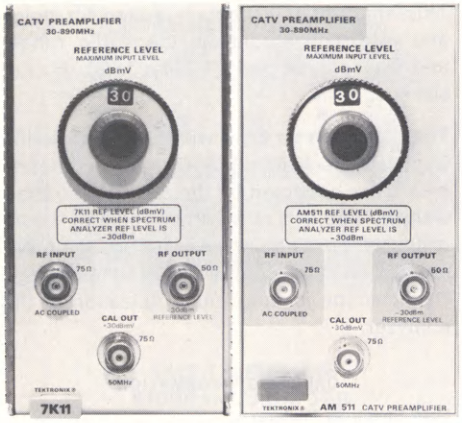
Option 6 Internal S.A. Graticule

***7704A Oscilloscope**

***R7704 Oscilloscope**

*Suggested Mainframe. See General Catalog for oscilloscope specifications and options.

CATV Preamplifiers, Sweep Generator, Attenuators, TV Trigger Synchronizer



7K11 AND AM511 CATV PREAMPLIFIERS

These plug-in preamplifiers are designed for spectrum analyzer applications where extra sensitivity is required. The 7K11 is a 7000-Series plug-in while the AM 511 fits into the TM 500 modular series power supplies.

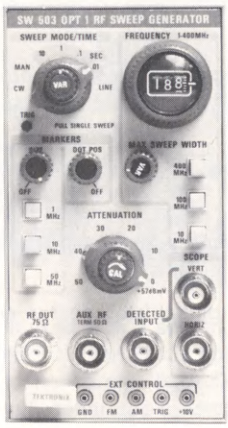
The amplifiers are tailored to the CATV and field intensity measurement markets, providing a 75 Ω input impedance and calibration in dBmV. The low noise figure makes the preamplifiers well suited for signal-to-noise and low level radiation measurements.

ORDERING INFORMATION

7K11 CATV Preamplifier

AM511 CATV Preampilfier

TM 501 Power Module



SW503 50 Ω RF SWEEP GENERATOR
SW503 OPT 1 75 Ω RF SWEEP GENERATOR

1 to 400 MHz Range

1, 10, and 50 MHz Markers Built-in

Continuously Variable Dot Marker System

+10 dBm (+57 dBmV Output)

Remote Programming Capability

The SW503 Sweep Generator is a small compact unit, which incorporates most of the features associated with larger laboratory type sweep generators, and is designed to operate in a TM500 Series Power Module.

The instrument covers a frequency range of 1 to 400 MHz. It has a variable sweep rate, step attenuator, 20 dB vernier attenuator, and a crystal controlled marker generator which provides comb type markers at 1, 10, and 50 MHz.

A unique feature of the SW503 when used in conjunction with a DC502 Digital Counter with option 7 installed, is its ability to provide a variable marker covering the entire 1 to 400 MHz frequency range with the marker frequency read directly on the digital counter.

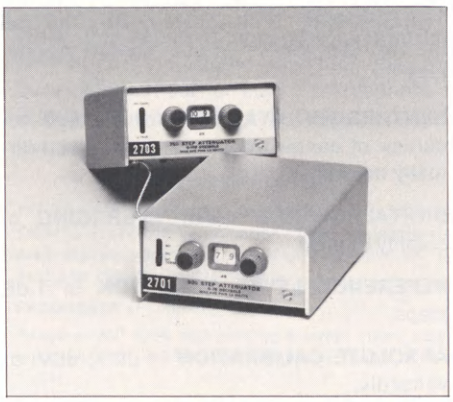
This combination will also provide a CW output, read to the counter accuracy. This CW signal can be amplitude or frequency modulated by externally applied signals.

The versatility and many features of the SW503 make it an excellent choice for specialized sweep testing or for general laboratory use.

ORDERING INFORMATION

SW503 RF Sweep Generator
(Calibrated −40 to +10 dBm, 50 Ω).

SW503 OPT 1 RF Sweep Generator
(Calibrated 7 to +57 dBmV, 75 Ω).



2701 AND 2703 STEP ATTENUATORS

The 2701 and 2703 Step Attenuators are laboratory quality, bench top instruments for attenuation of large value radio frequency signals. The 2701 50 Ω Attenuator is particularly useful in making receiver sensitivity and distortion measurements. The range of attenuation is 0 to 79 dB, selected in 1 dB steps with tens and units cam switches.

The 2703 75 Ω Step Attenuator is tailored for television, CATV, telephone, and radio applications. A front-panel switch extends the range to 109 dB, making the attenuator an ideal accessory for wide-range measurements such as cross modulation, signal-to-noise, and receiver sensitivity. A block has been incorporated on both rear-panel ports to protect the attenuator against accidental burnout from high dc offsets or ac power on center conductors.

The attenuators may be used for frequencies up to 2 GHz, with slight degradation of the attenuation accuracy and vswr characteristics specified at 1 GHz.

ORDERING INFORMATION

2701 50 Ω Step Attenuator

2703 75 Ω Step Attenuator

TV TRIGGER SYNCHRONIZER

525/60 TV Systems (Only)

For use with Tektronix 7L12 or 7L13 Spectrum Analyzer.

The TV Trigger Synchronizer provides a variable trigger signal which can be used to synchronize a spectrum analyzer sweep with a TV sync signal for analysis of the composite video. Battery power is provided by an 8.4 volt mercury battery (146-0019-00).

CONTROLS AND CONNECTORS

Power Switch

Battery Level Indicator

Sync Control

Provides a fine control of crystal frequency to allow the oscillator frequency to be synchronized with the TV sync frequency.

Frame Position Control
Varies the output pulse position with respect to the TV sync signal. Any portion of the composite video signal can be viewed over a range of approximately 1.8 fields or 0.9 frames.

Trigger Output Connector (BNC)
Provides 4 volt (minimum) negative differentiated trigger pulse.

ORDERING INFORMATION

015-0261-00 TV Trigger Synchronizer

APPLICATION NOTES AVAILABLE

Numerous application notes and magazine article reprints on spectrum analyzer measurements are available. Notes on AM, FM, and Television Measurements, Cable Television Proof of Performance, Audio Amplifier Testing, Noise and Pulse Testing, and others have been written to help you with your measurements.

In addition, our staff of specialists stands ready to help you solve any special measurement problems. Contact your local TEKTRONIX Field Office.

The cameras discussed on these pages meet the trace-recording requirements for the TEKTRONIX Oscilloscopes and Display Units used for television applications.

CAMERA SELECTION CHART

Instrument Type	C5	C-27-P Option 1	C-59-P	C-30A-P Option 1
520A, 521A, 522A		●	●	
528	●	●	●	●
1480, 1481, 1482, 1485		●	●	
1420, 1421, 1422	●	●[1]	●[1]	●[1]
602	●	●	●	●
604	●			
7000 Series	●	●	●	●
465				●

● Indicates camera will fit instrument

[1]1420, 1421, 1422 do not have illuminated graticules and must be factory modified to work with this camera. (special quotation required).

CAMERA/ADAPTER SELECTION CHART*

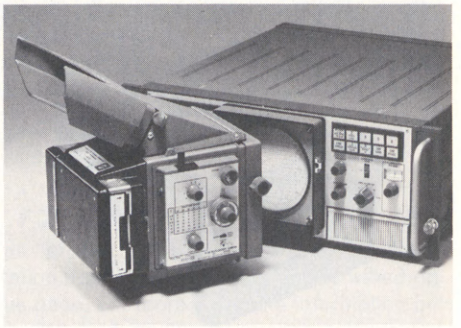
Instrument Type	C-27-P Option 1	C-59-P	C-30A-P Option 1
520A, 521A, 522A	016-0295-00	016-0295-00	
528, 602, 1420 1421, 1422 7000 Series	016-0249-03	016-0249-03 (Included with Camera)	016-0248-00
1480, 1481, 1482, 1485	016-0342-00	016-0342-00	

No adapter required with C/5 Camera, or 465 when used with C/30A Option 1.

PHYSICAL CHARACTERISTICS

	C-59-P		C-5A		C-27-P Option 1		C-30A-P Option 1	
Camera Dimensions	**in**	**cm**	**in**	**cm**	**in**	**cm**	**in**	**cm**
Height	11.5	29.2	5.5	10.0	17.2*	43.6	5.1	13.0
Width	7.7	19.3	6.6	16.8	7.5	19.1	7.5	19.1
Length	10.8	27.3	10.1	25.7	13.4*	34.1	10.4	26.4
Weights	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**
Net Weight	7.0	3.2	2.9	1.3	10.5	4.7	5.0	2.3
Shipping Weight	11.0	5.0	5.0	2.3	14.0	6.3	9.0	4.1

*Without viewing tunnel, the C-27 height is 8 in and length is 12 in.



520A Vectorscope with a C-59-P Camera.

C-59-P CAMERA

The C-59-P features range-finder focusing and a photometer exposure aid that allows the operator to quickly and easily set the camera controls for sharp, correctly-exposed photographs. The camera can be quickly lifted off when not needed, or swung open to provide full view of the display area. Removal of the viewing tunnel allows rackmount stacking of the camera on 7 inch vertical centers. The shutter is mechanically actuated with 6 selectable speeds from 1 to 1/50 second, plus Time and Bulb. The C-59 lens has a magnification of 0.67. The aperture is continuously adjustable from f/2.8 to f/16.

Order C-59-P Camera, Pack-Film Back
(Includes 016-0249-03 Adapter)

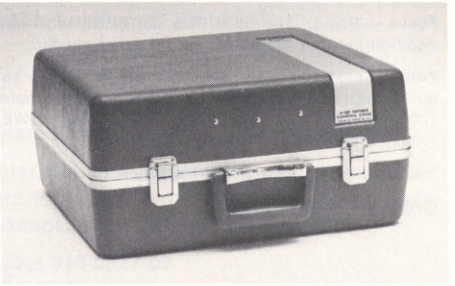
OPTIONS

Mounting Adapter **016-0295-00**
For 520A, 521A, 522A.

Mounting Adapter **016-0342-00**
For 1480, 1481, 1482, 1485.

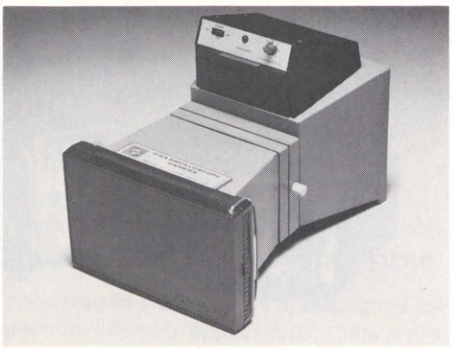
Carrying Case **016-0177-00**

Holds a complete C50 Series camera with extra film-backs and accessories.

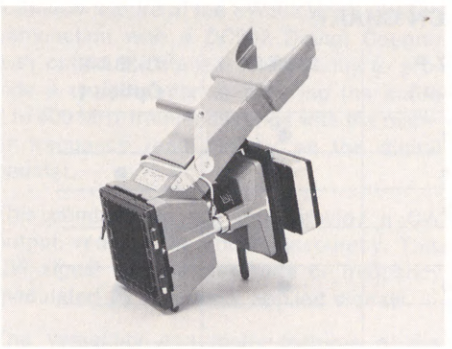


Optional Camera Carrying Case

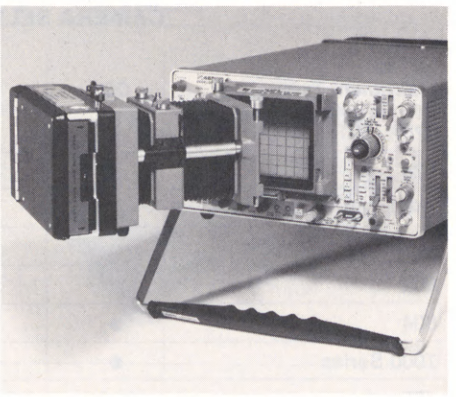
OSCILLOSCOPE CAMERAS



C-5A CAMERA



C-27-P Option 1 Camera



465 Option 5 Oscilloscope with a C-30A Option 1 Camera

Easy to Use

Fixed Focus

Lightweight

Low Cost

Graticule Illumination

The C-5A is a low-cost general-purpose camera with a Polaroid Pack-Film Back and pulsed graticule illumination. The C-5A attaches directly to recommended instruments without need for an adapter. It also mounts directly onto all 5400-Series and 7000-Series Oscilloscopes, the 602 and 604 Display Units, and the 577 Curve Tracer.

Graticule illumination is provided by an internal xenon flash lamp. The burst of light illuminates the phosphor, causing it to glow and back-light the dark graticule lines. The illumination is easily adjustable. The option 1 model does not have graticule flash.

Lens — f/16 (fixed) with a magnification of 0.67 or 0.85.

Shutter — Mechanically actuated with speeds of 1/5, 1/10, and 1/25 second plus BULB and TIME.

Focus — Fixed. The lens has an extremely wide depth-of-field so adjustable focus is not needed.

Power Required — Two standard AA transistor batteries for graticule illumination. Typical life; approx 1200 flashes or more if GRATICULE FLASH POWER switch is turned off between flashes.

Includes — Two AA Penlight batteries.

Order C-5A Camera

Rotating and Sliding Film-backs

Interchangeable Lenses

Lens—f/1.9, 0.7 magnification.

Film Economy—Records three 4 x 10 cm on 3¼ x 4¼ in film.

Included Accessories—Cable release (122-0586-02); split-image focus plate for Polaroid Pack-Film Back (387-0893-02); split-image focus plate for Polaroid Roll-Film Back (387-0893-01).

Order C-27-P Camera Option 1, Pack-Film Back

(Without Option 1, the standard lens has 0.85 magnification ratio and will not photograph the entire graticule of the 520A series.)

Options

Mounting Adapter **016-0295-00**
For 520A, 521A, 522A

Mounting Adapter **016-0249-03**
For 528, 602, 1420, 1421, 1422, 7000 Series.

Mounting Adapter **016-0342-00**
For 1480, 1481, 1482, 1485.

Carrying Case **016-0208-01**
Holds one C-27 Camera

C-30A Option 1 Camera

The C-30A Option 1 is a compact, lightweight camera recommended for the 465 Option 5 Television Oscilloscope. The camera includes an Adapter Frame/Corrector Lens which increases the camera's field of view so that the full 8 x 10 cm CRT display area of the 465 Oscilloscope can be recorded.

The C-30A f/1.9 lens has a magnification of 0.80, and mechanically actuated shutter with 7 selectable speeds from 1 to 1/60 second plus Time and Bulb. An optional electric shutter model is also available. The camera also features a lift-off mounting and swing-away hinging.

Order C-30A-P Option 1 Camera, Pack-Film Back.

Options

Mounting Adapter **016-0248-00**
For 528, 602, 1420, 1421, 7000 Series.

Carrying Case **016-0587-00**
Holds any C-30 Series Camera. Room for additional film-back, additional adapter or film.

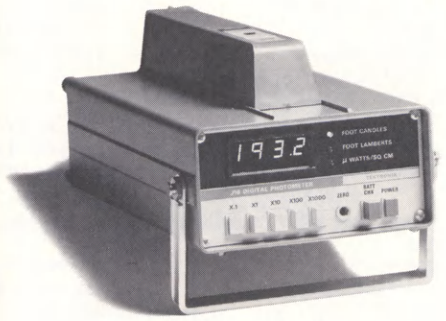
For complete information on all TEKTRONIX cameras and accessories, please consult TEKTRONIX 1976 Products Catalog available upon request.

For additional ordering information see last page.

J16-TV

DIGITAL PHOTOMETER-RADIOMETER

This is a photometer/radiometer for a variety of television light measurements.



Television Applications
Matching Color Monitors
Measurement of Studio Lighting

Simple-to-Use

Completely Portable

The TEKTRONIX J16-TV is a portable digital photometer/radiometer capable of making a variety of light measurements in the television station. The J16-TV package includes: J16 Battery-operated Photometer, J6502 Irradiance Probe, Light Occluder, Probe Extension Cable, and Battery Charger.

The J16-TV is an excellent transfer mechanism which provides a simple, accurate method for adjustment of monitor screen color temperature. The primary colors are measured and adjusted to produce white color temperature balance.

The J16-TV with optional J6503 or J6523 measures monitor screen brightness on both color and black and white monitors. Other applications include measurement of studio lighting, camera lighting, and illumination of work areas.

Nine quickly interchangeable precalibrated probes are available for measuring illuminance, irradiance, luminance, light-emitting diode output, and relative intensity. All probes use silicon photodiode sensors for maximum stability. A HOLD switch is provided with all probes to allow the reading to be stored at any time.

The 3½ digit LED display can be easily read under a wide range of ambient light conditions. Integrated circuits are used extensively to achieve stable operation, low power requirements, small size, and light weight. Under normal usage, internal, rechargeable nickel cadmium batteries will only need recharging weekly. A battery charger is supplied with each J16. An AC power supply, replacing the battery pack, is available for continuous operation.

J6502 IRRADIANCE PROBE

The J6502 is used to adjust monitor screen color temperatures. The probe's spectral response is flat from 450 to 950 nanometers, ±7%, enabling individual measurement of the light output for red, blue, and green screens on a color monitor. In practice, the probe is placed against the center of the monitor screen. Bias and gain controls are adjusted for each primary color to produce color temperature balance. The J6502 measures irradiance in microwatts/cm² or milliwatts/m² (J6502 Opt 2).

J6511 ILLUMINANCE PROBE

The J6511 measures illuminance where light incident upon a surface must be measured. Applications for the J6511 include measurements of studio lighting, camera lighting, and illumination of work areas. The probe's spectral response very closely matches the CIE photopic curve (international standard for human eye response). This assures accurate measurements even when measuring spectrally different light sources. The response is also cosine corrected, giving a 180° field of view. Readout is in footcandles or lumens/m² (lux) (J6511 opt 2).

J6503 LUMINANCE PROBE (8°)

The J6503 measures monitor screen brightness on both color and black and white monitors. The probe may also be used to measure light reflected by studio scenes. In practice, the probe is pointed at the surface. The angle of view is 8°. The spectral response very closely matches the CIE photopic curve. The probe indicates luminance in footlamberts or candelas/m² (nit) (J6503 opt 2).

J6523 LUMINANCE PROBE (1°)

The J6523 is also usable for monitor luminance and studio lighting but has the advantages of being able to measure a small spot and an optical system so that the exact area being measured can be viewed through the eyepiece. The focusing range is 18 inches* to infinity. The spot measured is about 0.2 inches* in diameter at 18 inches and proportionally larger at greater distances. The spectral response matches the CIE Photopic curve and the readout is in footlamberts or candelas/m² (J6523 Option 2).

*Less with commercially available photographic close-up lenses.

FOR ADDITIONAL INFORMATION

The probes recommended for television station applications have been described on this page. For more complete information on the J16 and additional probes, please request our brochure on the J16 Digital Photometer/Radiometer. Several application notes are available, including ones on picture monitor color temperature adjustments and studio lighting.

ORDERING INFORMATION

J16-TV Package—for tv color monitor set-up. The package includes J16 Battery-Operated Photometer, J6502 Irradiance Probe, Light Occluder, Probe Extension Cable, and Battery Charger.

Order J16-TV for 115 V, 50/60 Hz battery charger.

Order J16-TV Option 1 for 230 V, 50/60 Hz battery charger.

For a J16-TV with metric readout, specify **Option 2** in addition to above ordering information. No additional charge.

OPTIONAL PROBES

Specify probe with **option 2** for metric readout J16's no additional charge.

Actual spectral curve of any probe is available on initial order. Specify **option 5.**

J6511, Illuminance Probe,
cosine corrected.

J6503, Luminance Probe (8°).

J6523, Luminance Probe (1°).

OPTIONAL ACCESSORIES

Spare Battery Pack — Order **016-0539-01**

Filter Holder—mounts one-inch diameter filters, of up to ⅜ inch thickness, to probes (except J6511, J6512, J6514, J6523).

Order 016-0527-00

Ac Power Supply—allows J16 to be used without batteries.

Order 119-0404-00 115 V, 50-400 Hz.

Order 119-0404-01 230 V, 50-400 Hz.

ACCESSORIES

The accessories here are particularly useful in video applications.

ACCESSORIES FOR SPECTRUM ANALYZERS

75 Ω	
feedthrough termination	**011-0055-00**
10X attenuator	**011-0061-00**
50 Ω to 75 Ω	
min loss attenuator	**011-0057-00**
75 Ω to 50 Ω	
min loss attenuator (ac coupled)	**011-0112-00**

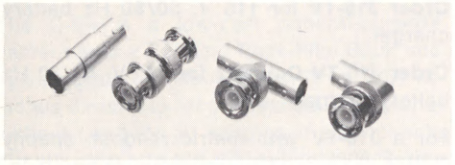
CHARACTERISTICS

Accuracy of Indicated Attenuation Ratio is ±2% at dc. Power Rating of attenuators is ½ watt and terminations 1 watt. Voltage Standing Wave Ratio (VSWR) not specified.

ADAPTERS

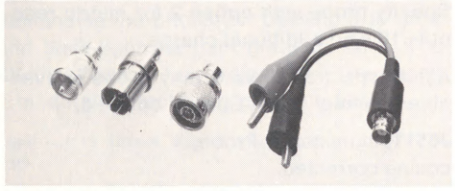
BNC — FROM LEFT TO RIGHT

Male to UHF Female	**103-0032-00**
Male to GR	**017-0064-00**
Male to N Female	**103-0058-00**
Male to Binding Post	**103-0033-00**
Male to Dual Binding Post	**103-0035-00**
Female to Dual Banana	**103-0090-00**



BNC — FROM LEFT TO RIGHT

Female to BNC Female	**103-0028-00**
Male to BNC Male	**103-0029-00**
T	**103-0030-00**
Elbow Male to Female	**103-0031-00**



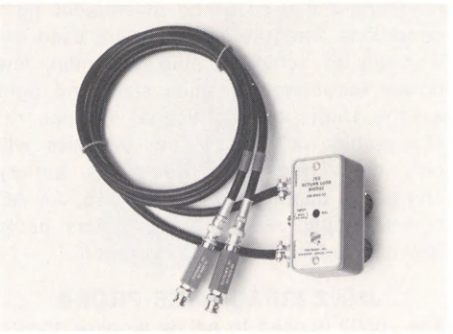
BNC — FROM LEFT TO RIGHT

Female to UHF Male	**103-0015-00**
Female to GR	**017-0063-00**
Female to N Male	**103-0045-00**
Female to clip leads	**013-0076-00**

BNC CABLES

Coaxial	
50 Ω, 18 in	**012-0076-00**
50 Ω, 42 in	**012-0057-01**
75 Ω, 42 in	**012-0074-00**
93 Ω, 42 in	**012-0075-00**
75 Ω, 300 in (25 ft)	**012-0157-00**

75 Ω RETURN LOSS BRIDGE



This Return Loss Bridge is compact and rugged. It features passive components and simple construction. It is designed to measure impedance errors in a 75 Ω system in terms of return loss, using a wideband, high-gain differential amplifier and oscilloscope (TEKTRONIX 1A5/547 or 7A13/7000-Series) as the error detector. The TEKTRONIX 011-0103-00 and 011-0103-01 are 75 Ω, 0.2% double-ended termination resistors supplied as removable bridge arms. Two matched coax cables extend the bridge arms and are permanently attached to the bridge. Either or both bridge arms can be disconnected for max flexibility, during calibration and in making measurements.

The bridge can be driven by a number of different sources such as VIT test signals, square waves, sine-waves, sine-squared pulses, multiburst, and swept-frequency sine waves. With the Return Loss Bridge coupled to the differential amplifier and oscilloscope, a television test signal such as the multi-burst can be used to measure impedance errors over the complete video spectrum with a single measurement.

CHARACTERISTICS

Return Loss—At least 54 dB, DC to 10 MHz.

Max Input Voltage—6 V RMS (6 V RMS, DC to 1.2 MHz decreasing to 0.7 V RMS at 10 MHz when used with Type 1A5 or 7A13).

Return Loss Bridge, order **015-0149-00**

NOISE MEASUREMENT FILTERS

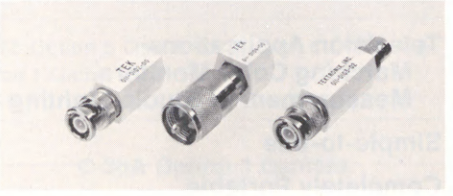
147A NTSC Gen .....SEE PAGE 22
148 PAL Gen .....SEE PAGE 32
148M PAL-M .....SEE PAGE 40

75 Ω Voltage Step-up Terminations

520A VECTORSCOPE .....SEE PAGE 76
521A VECTORSCOPE .....SEE PAGE 79
522A VECTORSCOPE .....SEE PAGE 79

SINGLE SIDEBAND CHROMA AMPLITUDE CORRECTOR

520A VECTORSCOPE .....SEE PAGE 76
521A VECTORSCOPE .....SEE PAGE 79
522A VECTORSCOPE .....SEE PAGE 79



TERMINATIONS

75-ohm termination. 75 ohms within 0.5% (at dc). Return loss is at least 52 dB, dc to 10 MHz, max input voltage is 5 V RMS, center conductor to ground.

BNC, order **011-0102-00** (Left in photo).

UHF, order **011-0104-00** (Center in photo).

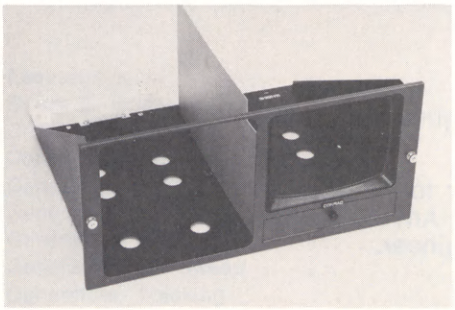
75-ohm feed through termination. 75 ohms within 0.2% (at dc). Return loss is at least 52 dB, dc to 10 MHz, max input voltage is 3 V RMS, center conductor to ground.

BNC, order **011-0103-02** (Right in photo)

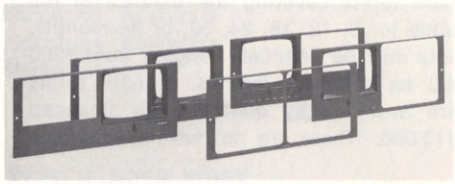
1480 Series Graticules

Included With Monitor

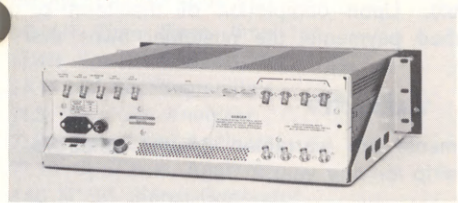
	External									Internal
	Blank 331-0393-00	NTSC Composite 331-0393-01	CCIR 331-0393-02	CCIRK Visual 331-0393-05	CCIRK Photo 331-0393-07	GRAT A Visual 331-0393-08	GRAT B Visual 331-0393-09	GRAT A Photo 331-0393-10	GRAT B Photo 331-0393-11	Inside CRT
1480R or C	●						●		●	GRAT A
1481R or C	●			●	●					CCIR
1482R or C	●									CCIR
1485R or C	●	●		●	●	●	●	●	●	CCIR



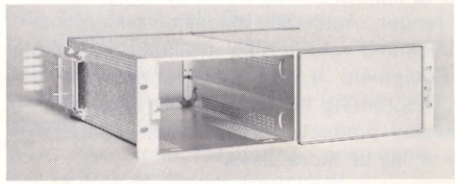
Cradle assembly 014-0020-00 with optional bezel 014-0023-00 for mounting a 1480C Series Waveform Monitor alongside a 9 inch Conrac picture monitor.



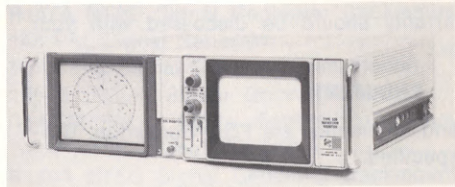
Optional bezels for use with cradle assembly 014-0020-00 include 014-0038-00, 014-0023-00, 014-0022-00, 014-0037-00, and 014-0024-00.



Cradle assembly 426-0309-00 is used to mount a 1480R Series Waveform Monitor in a WECO backless rack.



Rack adapter 016-0115-02 with blank panel 016-0116-00 is used for mounting a 528 Waveform Monitor, a 602 Option 5 Display Monitor, or a 1420 Series Vectorscope in a standard 19 inch rack. Without the blank panel two instruments can be mounted side-by-side.



604 Option 5 with Option 3 side by side with 528 Waveform Monitor in rackmount conversion kit 016-0337-00.

FOR USE WITH 520A SERIES:

Cradle Assembly—for mounting the 520A, 521A, or 522A in a WECO backless rack **426-0667-00**

FOR USE WITH 528 WAVEFORM MONITOR:

Rack Adapter for side-by-side mounting of 528's order **016-0115-02**

Panel Assembly—For covering ½ of rack adapter when only one 528 is rackmounted **016-0116-00**

FOR MOUNTING 9 INCH SNA-9 PICTURE MONITOR (requires 8¾ inches rack space)

Mounting Cradles—A cradle assembly, with associated bezel and mounting brackets, allows the 528 Waveform Monitor to be mounted alongside a 9 in Conrac Picture Monitor, in a standard 19 in rack.

Cradle Assembly* **014-0020-00**
(Order 528 or 528 Option 3 for use in this cradle. The cover supplied with the instrument is required for cradle mounting).

Bezel and brackets for mounting 528 on operator's right **014-0037-00**

Bezel and brackets for mounting 528 on operator's left **014-0038-00**

*Also order the appropriate bezel and brackets for mounting.

FOR USE WITH 602 OPTION 5:

Rack Adapter—Two 602 Option 5's may be mounted side-by-side using the 5¼ in optional rack adapter, or a 602 Option 5 may be mounted side-by-side with a 1420 Series or 528 ..... **016-0115-02**

Panel Assembly—For covering ½ of rack adapter when only one 602 Option 5 is rackmounted **016-0116-00**

FOR USE WITH 604 OPTION 5:

5¼ inch Rack Conversion Kits

Note: If rackmount conversion kit is to be used, be sure to order your 604 option 5 with the option 3 deduction of handle and feet.

Cabinet-to-rackmount Conversion Kits, equipped with slide out assembly required to rackmount:

604 Option 5 with Option 3 in a standard rack width includes securing hardware and blank front panel when only one Instrument is utilized **040-0601-00**

Two 604 Option 5 with Option 3 side by side in a standard rack width **040-0600-00**

604 Option 5 with Option 3 side by side with 528 in a standard rack width **016-0337-00**

TM 503 Modular Test System and a 604 in a standard rack width **040-0624-00**

Rackmount-to-Cabinet Conversion Kit required to convert a rackmount 604 to a cabinet style .. **040-0602-00**

FOR USE WITH 1420 SERIES:

Rack Adapter—For mounting two 1420 Series Vectorscopes side-by-side, or mounting a 1420 Series Vectorscope side-by-side with a 528 Waveform Monitor **016-0115-02**

Panel Assembly—For covering ½ of rack adapter when only one 1420 Series Vectorscope is rackmounted **016-0116-00**

FOR USE WITH 1480 SERIES:

Mounting Cradles—A cradle assembly, with associated bezel, allows the 1480C Waveform Monitor to be mounted alongside a 9 in Conrac Picture Monitor in a standard 19 in rack. A cradle and bezel are also available for mounting two 1480Cs side-by-side.

FOR MOUNTING 9 INCH SNA-9 PICTURE MONITOR (Requires 8¾ inches rack space)

Cradle Assembly **014-0020-00**

Bezel, for mounting 1480C on operator's left **014-0023-00**

Bezel, for mounting 1480C on operator's right **014-0024-00**

FOR MOUTING TWO 1480C WAVEFORM MONITORS SIDE-BY-SIDE (requires 8¾ inches rack space)

Cradle Assembly **014-0020-00**

Bezel **014-0022-00**

1480R Cradle Assembly—For mounting the 1480R in a WECO backless rack **426-0309-00**

BENCH TO RACKMOUNT KITS

140 SERIES **040-0574-02**
520 SERIES **040-0491-02**
632 PICTURE MONITOR..... **016-0547-00**

RACKMOUNT TO BENCH KITS

140, 141A, 142, 144, 145, 145M, 147A, 148, 148M, 149A..... **040-0573-00**
146 ..... **040-0589-00**
520 SERIES **040-0490-00**

CARRYING CASES (FIELD CASE)

528 ..... **390-0018-01**
1480C, 1481C, 1482C, 1485C..... **437-0195-00**
1420, 1421, 1422 ..... **390-0018-01**

PROTECTIVE VINYL COVER FOR 1480 SERIES CABINET STYLE WITH FIELD CASE
1480C, 1481C, 1482C, 1485C **016-0085-00**

BUSINESS INFORMATION

General Terms Of Sale And Warranty

Orders should be placed with your Tektronix Field Engineering Office listed on the back cover.

Tektronix, Inc., offers many different terms of sale in order to meet varied purchasing objectives and to assist in financial planning. Any of the following terms may be arranged with a Tektronix Field Engineer.

NET 30 DAYS

Tektronix, Inc., standard terms of sale are NET 30 days following the date of shipment.

EXTENDED TERMS OF SALE

Extended terms of 60 to 120 days are available on the same single payment basis as standard terms. Since the cost of extended terms is not included in catalog prices, a service charge is added to the catalog price. The amount of the service charge depends upon the number of days the terms are extended.

LEASE AGREEMENT

All new and used instruments are available under this program. Accessories and parts are not available unless they are associated with the products being leased. Minimum lease is $1000.

A standard lease term of 12, 18, 24, 30, and 36 months is offered. Longer terms are negotiable. Under a Lease Agreement, the customer pays for the use of the product for the term of agreement. It is not a month-to-month rental . . . it is a non-cancellable, fixed-term lease requiring no advance payment. At the expiration of the lease there is the opportunity to update the instruments, to renew the existing lease, or to return the equipment at the expense of Tektronix, Inc. The customer may exercise an option to purchase the equipment at any time during the term of the lease, provided he gives thirty days written notice. A portion of the installments will be credited toward the purchase price.

The standard Tektronix, Inc., warranty and quantity discount apply to products leased under this installment term.

SECURITY AGREEMENT

This program provides monthly installment payment terms while TEKTRONIX products are in use. Accessories and parts are not available unless they are associated with the products being purchased. New and used products may be purchased with a deduction for applicable quantity discounts.

An advance payment equal to approximately 10% of the purchase price of the equipment desired is required for a Security Agreement. Installment terms covering the balance of the contract price are available for 6, 12, 18, 24, 30, or 36 months. Minimum balance amounts may be financed, ranging from $200 for six months to $2000 for thirty-six months. Longer terms of 48 to 60 months are available by quotation for financed balances of more the $10,000. There are no maximum finance balances.

All products carry the standard Tektronix, Inc., warranty. The customer is responsible for the equipment and applicable property taxes, licenses, etc. Upon completion of the term of agreement and prescribed payments, the customer owns the equipment.

WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year.

Information Display Products

Most information display products are available under an operating lease program. The minmum fixed terms of this program are 12, 24, 36 months or longer. Automatic extension on a month to month basis with a declining rate is also available after the fixed minimum term. Equipment leased on this program is maintained by Tektronix, Inc., during the terms of the agreement. Rental of information display products for customer evaluation is available for periods of 90 or more days.

During the term of the operating leases or rentals described, the customer may exercise an option to purchase the equipment provided 30 days notice is given. A portion of the installments already paid will be credited toward the purchase price.

Questions regarding warranty should be discussed with your Tektronix Field Engineer.

SHIPMENT

All prices, quotations, and shipments are FOB Beaverton, Oregon, unless otherwise specified.

Unless otherwise specified, shipment will be made via most economical method. Surface and air shipments will be insured at full valuation unless your order instructs otherwise.

TYPE NUMBER INDEX

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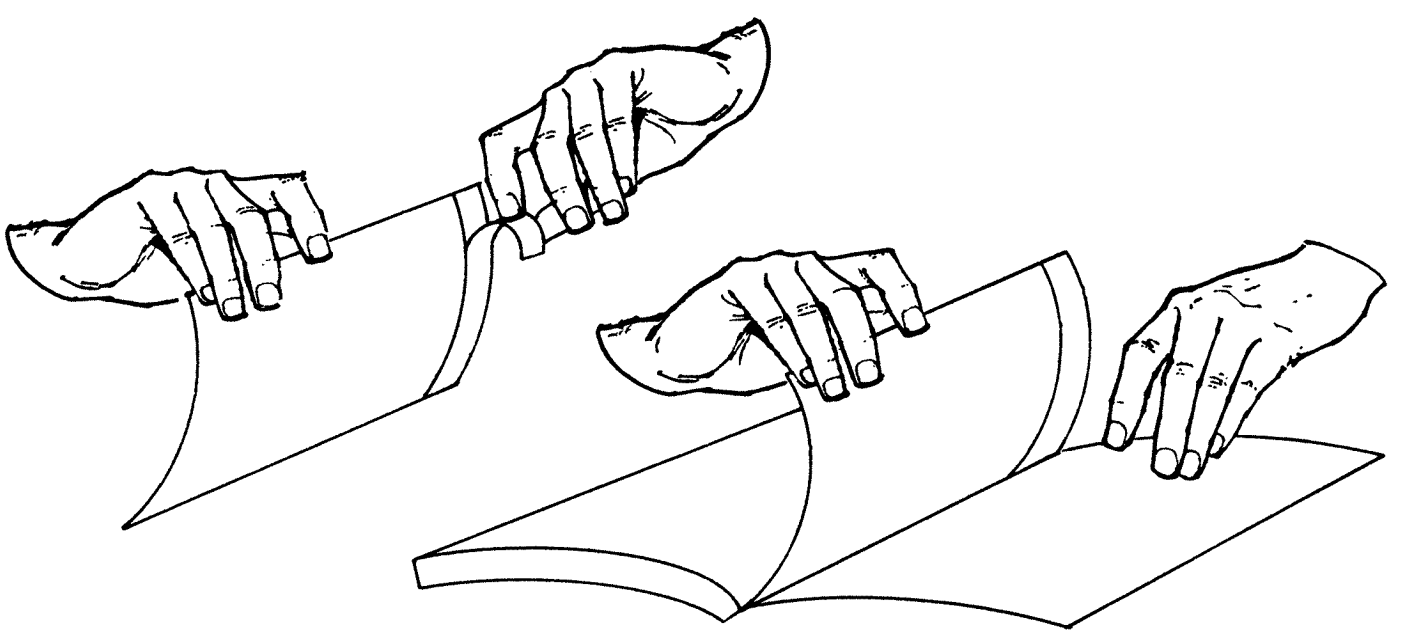
TELEVISION PRODUCTS PRICE LIST

Effective November 15, 1976

Please attach this price list to the inside back cover of the 1976 Tektronix Television Products Catalog with the adhesive strip on the back. Simply remove the protective strip and press in place. If you do not have a copy of the catalog or want extra copies of this price list please contact your nearest Tektronix Field Office, or write: Tektronix Inc., Box 500, Beaverton, Oregon 97077.

This price list is organized by catalog page number. All prices for a product group and the recommended accessories for that product group will be found in the same sequence followed on the product pages under **Ordering Information.**



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TELEVISION PRODUCTS PRICE LIST

Effective November 15, 1976

Page 10

1410C Generator (cabinet)	$910
1410C Generator (cabinet) Option 1 (1 Hz)	1010
1410R Generator (rackmount)	940
1410R Generator (rackmount Option 1 (1 Hz)	1040
SPG1 Sync Generator	1125
SPG2 Sync Generator	1340
SPG3 Sync Generator	270
TSG1 Color Bars Generator	645
TSG2 Convergence Generator	215
TSG3 Linearity Generator	535
TSG4 Black Burst Generator	215
333-2162-00 Two-wide blank panel	1.65
333-2171-00 One-wide blank panel	1.35

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1470 CCTV Color Sync and Test Signal Generator	2400
Option 1, Sync Generator Without Genlock	2150
1474 CCTV Color Sync Generator	1100
Option 1, Sync Generator Without Genlock	850

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140 NTSC Signal Generator*

R140 Signal Generator* (rackmount)

144 NTSC Signal Generator*

R144 NTSC Signal Generator* (rackmount)

146 NTSC Signal Generator*

R146 Signal Generator* (rackmount)

*Contact your Tektronix Field Office for prices and availability on these items.

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147A NTSC Signal Generator	3990
R147A NTSC Signal Generator (rackmount)	3990
147A Option 1 NTSC Signal Generator (rackmount)	3990
R147A Option 1 NTSC Signal Generator (rackmount)	3990
149A NTSC Signal Generator	4700
R149A NTSC Signal Generator (rackmount)	4700
149A Option 1 NTSC Signal Generator	4700
R149A Option 1 NTSC Signal Generator (rackmount)	4700
015-0212-00 Low-Pass 4.2 MHz 525/60	90
015-0214-00 Noise-Weighting 4.2 MHz 525/60	60

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145 PAL Gen-Lock Test Signal Generator	$4550
R145 PAL Gen-Lock Test Signal Generator (rackmount)	4550

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141A PAL Signal Generator	2825
Option 1 (convergence)	Add 275
R141A PAL Signal Generator (rackmount)	2825
Option 1 (convergence)	Add 275

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148 Test Signal Generator	4410
R148 Test Signal Generator (rackmount)	4410
Option 1 Australian Test Signals with 10 T Filter	Add 775
Option 2 Australian Test Signals with 20 T Filter	Add 775
015-0213-00 Low-Pass 5.0 MHz 625/50	90
015-0215-00 Noise-Weighting 5.0 MHz 625/50	60
015-0220-00 Low-Pass 6.0 MHz 625/50	90

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145-M PAL Gen-Lock Test Signal Generator (cabinet)	5565
R145-M PAL Gen-Lock Test Signal Generator (rackmount)	5565

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142 PAL-M Signal Generator	3500
R142 PAL-M Signal Generator (rackmount)	3500

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148-M Test Signal Generator	5250
R148-M Test Signal Generator (rackmount)	5250
015-0212-00 Low-Pass 4.2 MHz 525/60	90
015-0214-00 Noise-Weighting 4.2 MHz 525/60	60

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1430 Random Noise Measuring Set (525/60)	2000
1430 Opt. 1 Random Noise Measuring Set (625/50)	2000
Option 2 (adds CMTT/1048E weighting filter)	Add 55

Page 46

1440 NTSC Automatic Video Corrector	$3090
1460 PAL Automatic Video Corrector	3375
015-0240-00 Remote Control Unit for 1440	300
015-0239-00 Remote Monitor Unit for 1440	450
015-0240-01 Remote Control Unit for 1460	300
015-0239-01 Remote Monitor Unit for 1460	450
012-0131-00 6-Foot Extender Cable	120
012-0637-00 3-Foot Extender Cable	130

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1441 VIR Signal Deleter/Inserter	1800
1461 Insertion Test Signal Generator Deleter/Inserter	1995
Option 1	Add 190

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1478 Calibrated Chrominance Level Corrector	1400

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650 NTSC	3300
650-1 NTSC + RGB	3420
651 PAL	3350
651-1 PAL + RGB	3470
652 PAL M	3610
652-1 PAL M + RGB	3730
655 NTSC + PAL	3625
655-1 NTSC + PAL + RGB	3745
*670A NTSC	2895
*670A-1 NTSC + RGB	3445
*671A PAL	2790
Option 2 Vector Display	Add 145
Option 4 (650 Series only)	NC

*The 670 Series has been superseded by the New 670A Series featuring aperture correction.

602 Option 5 (X-Y Monitor)	1175
604 Option 5 (X-Y Monitor)	955

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The 632, R632, and R632 Option 4 have been discontinued.

Page 64

1480C NTSC Waveform Monitor	2475
1480R NTSC Waveform Monitor	2550
1481C PAL Waveform Monitor	$2475
1481R PAL Waveform Monitor	2550
1482C PAL-M Waveform Monitor	2700
1482R PAL-M Waveform Monitor	2750
1485C PAL/NTSC Dual Standard Waveform Monitor	2700
1485R PAL/NTSC Dual Standard Waveform Monitor	2750
Option 1 1 Megohm, 20 pf Probe Input (probe not included)	Add 125
Option 2 with Carrying Case	Add 55
Option 3 with Blank CRT	NC
Option 4 Tone Wheel Sync	Add 340
Option 5 Tone Wheel Sync	Add 340
Option 7 Slow Sweep	Add 210
010-6108-03 10X Probe 2 Meters	49
010-6108-05 10X Probe 3 Meters	49
014-0020-00 Cradle Assembly	60
014-0023-00 Bezel	60
014-0024-00 Bezel	60
014-0020-00 Cradle Assembly	60
014-0022-00 Bezel	60
426-0309-00 1480R Cradle Assembly	15

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1480R Waveform Monitor Option 6	3400

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528 Waveform Monitor	1295
Option 1 (less cover)	Subtract 20
Option 2 (protective cabinet)	Add 40
Option 3 (for 625 line)	NC
014-0020-00 Cradle Assembly	60
014-0038-00 Bezel and Brackets	60
014-0037-00 Bezel and Brackets	60
016-0116-00 Panel Assembly	22

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1420 Vectorscope (NTSC)	1800
1421 Vectorscope (PAL)	1725
1422 Vectorscope (PAL-M)	1950
Option 1 Without Cabinet	Subtract 25
Option 2 Carrying Case	Add 40
016-0115-02 Rack Adapter	155

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520A NTSC Vectorscope (Cabinet)	36
R520A NTSC Vectorscope (rackmount)	3650

U.S. Sales Prices FOB Beaverton, Oregon

011-0100-00 Step-up Termination (UHF)	$45
011-0100-01 Step-up Termination (BNC)	43
011-0107-00 Chroma Corrector (UHF)	50
011-0107-01 Chroma Corrector (BNC)	60
426-0667-00 Cradle Assembly	20

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521A PAL Vectorscope (cabinet)	3510
R521A PAL Vectorscope (rackmount)	3510
522A PAL-M Vectorscope (cabinet)	3975
R522A PAL-M Vectorscope (rackmount)	3975
011-0109-00 Step-up Termination (521A BNC)	45
011-0100-00 Step-up Termination (522 UHF)	45
011-0100-01 Step-up Termination (522A BNC)	43
011-0108-00 Chroma Corrector (521 UHF)	55
011-0108-01 Chroma Corrector (521A BNC)	45
011-0107-00 Chroma Corrector (522 UHF)	50
011-0107-01 Chroma Corrector (522A BNC)	60
426-0667-00 Cradle Assembly	20

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602 Display Unit Option 5	1175
Option 1 (without cabinet)	-25
016-0115-02 Rack Adapter	130
016-0116-00 Panel Assembly	22
604 Display Unit Option 5	955
Option 3 (without handle, feet)	Subtract 10
040-0601-00 Rackmount Kit	112
040-0600-00 Rackmount Kit	80
016-0337-00 Rackmount Kit	200
040-0624-00 Rackmount Kit	65
040-0602-00 Rack to cabinet Kit	65

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7L12 Spectrum Analyzer	5300
7L13 Spectrum Analyzer	7850
7603 Mainframe	1850
Option 77 P7/Graticule	NC
13 Variable Persistence Mainframe	2950
Option 6 S.A. Graticule	Add 50
TR 502 Tracking Generator	$4650
TM 503 Option 7 Power Module	185
DC 502 Option 7 Digital Counter	1195
016-0195-01 Blank Panel	7.50
TR 501 Tracking Generator	3650
TM 503 Power Module	160
DC 502 Digital Counter	995
016-0195-01 Blank Panel	7.50
015-1002-00 Attenuator	120

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1405 Television Sideband Adapter (NTSC Marker Option)	2850

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5L4N Spectrum Analyzer	2650
5103N/D11 Storage Oscilloscope Order 5111 (cabinet)	1300
R5103N/D11 Storage Oscilloscope Order R5111 (rackmount)	1350
5A15N Single Trace Amplifier	175
5B10N Time Base Amplifier	275
7L5 Spectrum Analyzer	4650
L1 Plug-in Module (50 Ω)	450
L2 Plug-in Module (75 Ω)	450
7603 Oscilloscope	1850
R7603 Oscilloscope (rackmount)	2050
Option 6 Internal S.A. Graticule	NC
7704A Oscilloscope	2900
R7704 Oscilloscope	3900

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7K11 CATV Preamplifier	600
AM511 CATV Preamplifier	600
TM 501 Power Module	130
SW503 RF Sweep Generator	1450
SW503 OPT 1 RF Sweep Generator	NC
2701 50 Ω Step Attenuator	260
2703 75 Ω Step Attenuator	295
015-0261-00 TV Trigger Synchronizer	300

Page 89

C-59-P Camera, Pack-Film Back	660
016-0295-00 Mounting Adapter	40
016-0342-00 Mounting Adapter	42
016-0177-00 Carrying Case	130

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C-5A Camera	$250
C-27-P Camera Option 1	Add 20
016-0295-00 Mounting Adapter	40
016-0249-03 Mounting Adapter	48
016-0342-00 Mounting Adapter	42
016-0208-01 Carrying Case	145
C-30A-P Option 1 Camera	690
016-0248-00 Mounting Adapter	45
016-0587-00 Carrying Case	50

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J16-TV Package	1090
Option 1 (230 V)	NC
Option 2	NC
Option 4	NC
J6511 Illuminance Probe	350
J6503 Luminance Probe (8°)	350
J6523 Luminance Probe (1°)	980
016-0539-01 Battery Pack	100
016-0527-00 Filter Holder	15
119-0404-00 AC Supply (115 V)	140
119-0404-01 AC Supply (230 V)	150

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011-0055-00 Accessories for Spectrum Analyzers	20
011-0057-00 Accessories for Spectrum Analyzers	22
011-0061-00 Accessories for Spectrum Analyzers	24
011-0102-00 Termination	15
011-0103-02 Termination	20
011-0104-00 Termination	20
011-0112-00 Accessories for Spectrum Analyzers	35
012-0057-01 BNC Cable	12
012-0074-00 BNC Cable	12
012-0075-00 BNC Cable	11
012-0076-00 BNC Cable	11
012-0157-00 BNC Cable	18
013-0076-00 Adapter	12
015-0149-00 Return Loss Bridge	300
017-0063-00 Adapter	18.50
017-0064-00 Adapter	18.50
103-0015-00 Adapter	3.25
103-0028-00 Adapter	4.65
103-0029-00 Adapter	5.25
103-0030-00 Adapter	6
103-0031-00 Adapter	$5
103-0032-00 Adapter	4.50
103-0033-00 Adapter	4
103-0035-00 Adapter	11
103-0045-00 Adapter	11
103-0058-00 Adapter	6.50
103-0090-00 Adapter	6.50
331-0393-00 Blank Graticule	4
331-0393-01 NTSC Composite Graticule	4
331-0393-02 CCIR Graticule	4
331-0393-05 CCIR K Visual Graticule	4
331-0393-07 CCIR K Photo Graticule	4
331-0393-08 GRAT A Visual Graticule	4
331-0393-09 GRAT B Visual Graticule	4
331-0393-10 GRAT A Photo Graticule	4
331-0393-11 GRAT B Photo Graticule	4

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014-0020-00 Cradle Assembly	60
014-0022-00 Bezel	60
014-0023-00 Bezel	60
014-0024-00 Bezel	60
014-0037-00 Bezel and Brackets	60
014-0038-00 Bezel and Brackets	60
016-0085-00 Protective Vinyl Cover (Cabinet Style with Field Case)	14.50
016-0115-02 Rack Adapter	130
016-0116-00 Panel Assembly	22
016-0337-00 Rack Conversion Kit	200
016-0547-00 Bench to Rackmount Kit	50
040-0490-00 Rackmount to Bench Kit	60
040-0491-02 Bench to Rackmount Kit	90
040-0573-00 Rackmount to Bench Kit	90
040-0574-02 Bench to Rackmount Kit	90
040-0589-00 Rackmount to Bench Kit	90
040-0600-00 Rack Conversion Kit	80
040-0601-00 Rack Conversion Kit	112
040-0602-00 Rackmount-to-Cabinet Conversion Kit	65
040-0624-00 Rack Conversion Kit	65
390-0018-01 Carrying Case (Field Case)	42
426-0309-00 1480R Cradle Assembly	15
426-0667-00 Cradle Assembly	20
437-0195-00 Carrying Case (Field Case)	70

Tektronix Inc.
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PRICE INFORMATION ENCLOSED